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THE WORLD

OF

ART AND INDUSTRY.

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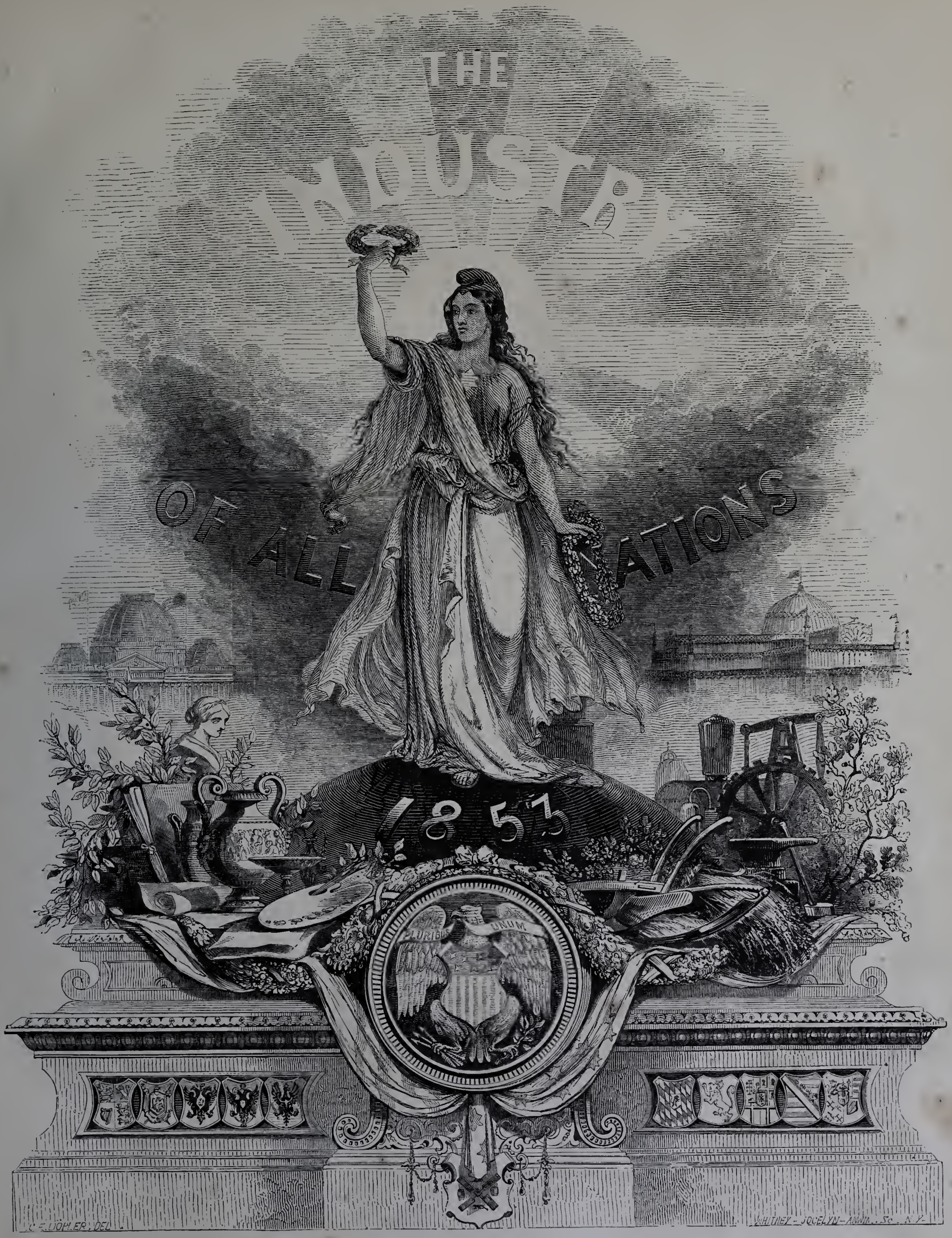

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THE WORLD

OF

SCIENCE, ART, AND INDUSTRY

ILLUSTRATED

FROM EXAMPLES

IN THE NEW-YORK EXHIBITION, 1853-54.

EDITED BY

PROF. B. SILLIMAN, JR., AND C. R. GOODRICH, ESQ.

AIDED BY SEVERAL SCIENTIFIC AND LITERARY MEN.

WITH 500 ILLUSTRATIONS,

UNDER THE SUPERINTENDENCE OF C. E. DÖPLER, ESQ.

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PUBLISHERS' NOTICE.

THE Editors of this work will give, in the preface, a statement of the plan and purpose of their labors; but the Publishers may be allowed to speak with some pride of their own part in the production of a volume, unique in this country, and upon which they have expended an amount of time, care, and money, which, if devoted to other objects, would certainly have produced a much greater pecuniary return. Few, indeed, not familiar with the details of a publisher's business, the difficulty of procuring competent artists and engravers, the high price which must be paid for the labors of such needful assistants, and the apparently inevitable and costly mistakes which always occur in the progress of a large illustrated work, can have any adequate conception of the laborious details, the continued anxiety, and the large expense attending such a publication; and it would be difficult to give a just idea of it within the proper limits of such a notice as this.

The work was undertaken with the determination that it should be carried on impartially, thoroughly, and independently; that the best artists and engravers in the country should be employed on their own terms; that no partiality should be purchased by those whose works are criticised or illustrated; that the best accessible information and assistance should be obtained for the editorial department; that the whole work should be prepared with reference to its *general and permanent value;* the present Exhibition being used merely to furnish a *text* and examples for the illustration of general principles. This plan has been conscientiously adhered to. Without any aid or favor whatever from the government of the Exhibition, or from the Exhibitors themselves,—access to the articles only excepted,—the undersigned have caused whatever was deemed worthy of illustration to be daguerreotyped, drawn and engraved, (excepting in one or two trifling instances,) *solely at their own expense.*

The whole cost of the volume thus produced, exceeds FORTY THOUSAND DOLLARS. But the publishers have at least the satisfaction of knowing, that whatever degree of favor it may meet with, it has been prepared carefully, impartially, honestly, and without fear or favor; and that its criticisms cannot have any the less weight or value, from the fact that they have been beyond the influence of merely selfish considerations.

Of the 504 engravings on wood contained in this work (one hundred, by the way—costing about $3,000—more than our prospectus promised to subscribers), four-fifths have been engraved in New-York, and chiefly by American engravers. It could not be supposed that this art, any more than others, has yet had time to attain perfection in this country; but many of the specimens in our volume indicate a respectable progress, if, indeed, they suffer in comparison with those of the admirable work which was partly our model—the London Art Journal—to the accomplished editor of which S. C. HALL, ESQ., we take the opportunity of returning thanks for practical courtesies and friendly suggestions.

Of these 504 *Illustrations*,

64 are devoted to Sculpture, Bas-Reliefs, &c.
120 " " " Manufactures in Metals, Bronzes, and Silver Ware.
17 " " " Textile Fabrics.
90 " " " Ornamental Furniture.
80 " " " Porcelain, Terra-Cotta, and Glass Ware.
40 " " " Machinery, Models, &c.
93 " " " Miscellaneous Articles, Interior Views, &c.

The letter-press includes papers on subjects of Scientific and Practical interest, by some of our most competent original investigators.

The whole volume furnishes information and examples which may be practically useful to a great variety of theoretical and practical men—to sculptors, designers, and engravers—to manufacturers and machinists—silversmiths and metal founders—to ship-builders and cabinet-makers, and many others engaged in the various mechanical and artistic pursuits; while as a drawing-room table-book, it may also prove attractive and useful to families—suggestive as it is of the sources of information on the various branches of science and human industry, and of the principles of taste which should govern in the ornamental and useful arts. In truth, it is a copiously and beautifully illustrated Encyclopedia of Manufactures and the Fine and Useful Arts; uniting to a brief but comprehensive history of each particular subject up to the date of publication, the theoretical and critical views of distinguished gentlemen who have made those subjects their special study. We are not aware that any other work of the kind can be mentioned which gives so much valuable information and expensive illustration at so low a price. We confidently assert that when the expense of its production is considered, no similar book excels it in cheapness. We have aimed to place it within the reach of all classes. As already mentioned, we have presented the subscribers to this work with several pages—including 100 engravings, over and above the number they were entitled to expect. Several other illustrations, for which we could not here find room, will be given in the Descriptive and Annotated Catalogue of the Exhibition—in which the machinery especially will be more fully described.

The publishers would merely add their acknowledgments to those who have had a part in the production of this volume. The paper, supplied from H. V. Butler & Co.'s mills in New Jersey; the type from J. T. White's foundry in New-York; the typography, stereotyping, and printing, from the extensive establishment of J. F. Trow, are all, it is believed, worthy to be compared with those of similar works produced in England or France. The drawings have been made under the able superintendence of Mr. C. E. Döpler, from daguerreotypes by Mr. H. Whittemore. The names of the engravers are, in most instances, affixed to each illustration; and the rates they have been paid would seem to indicate general prosperity in this branch of art if in no other. As to the Editors, their judicious and discriminating industry and ability are sufficiently indicated in the pages of the work.

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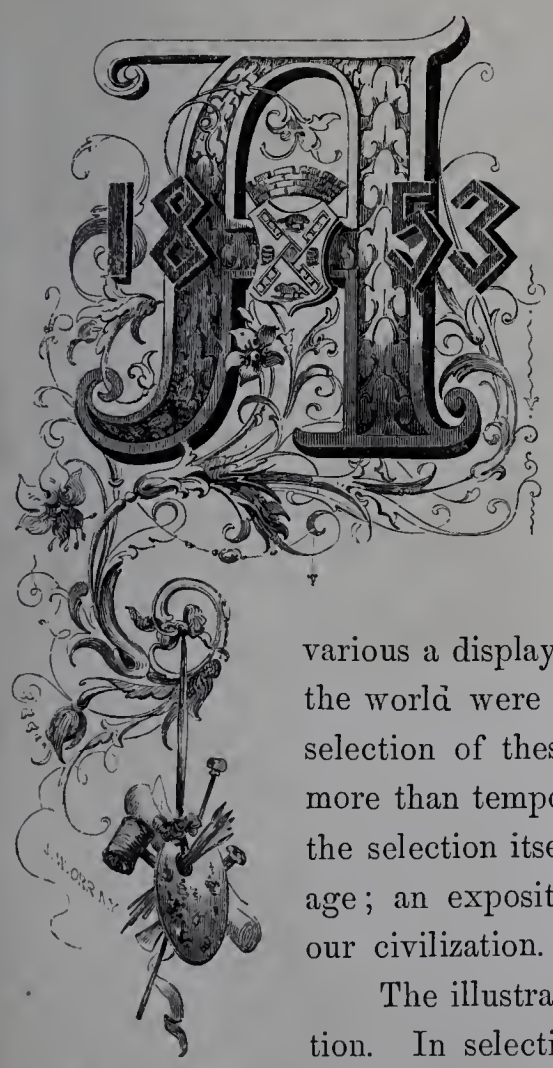
PREFACE.



SINCERE desire to extend the influence of pure and ornamental art—to promote a correct appreciation of what is really beautiful in the arts of design—to awaken in the people of the United States a quicker sense of the grace and elegance of which familiar objects are capable—and to encourage our manufacturers by placing before them the productions of European taste and skill, has influenced the preparation of the ILLUSTRATED RECORD.

The Editors present the volume to the public with the assurance that it will be found to be a faithful picture of the New-York Exhibition—a permanent record of what was there displayed most useful, interesting, and beautiful. It was not an undertaking of the Government; the national honor was not pledged to gather and select the national resources, or invite the contributions of foreign states, and secure for the enterprise the prestige of royal patronage. But still so rich and various a display was never before seen on this side the Atlantic. The labors of the workers of the world were largely, and often magnificently, represented, if not with entire completeness. A selection of these productions, exhibiting them by engraving and description, forms a work of more than temporary importance—a passing exhibition may be the occasion of preparing it, but the selection itself must derive its interest from the arts it illustrates. It is a partial picture of the age; an exposition of the comforts and luxuries, the manners and attainments, which belong to our civilization.

The illustrations of the RECORD were of course limited to the articles contained in the Exhibition. In selecting these, we have endeavored to inculcate the lesson which Americans most need to learn—the value and effect of an alliance of art with commercial industry. It was thought that an important benefit would be conferred upon our artisans and manufacturers by engraving a series of objects as practical lessons in ornamental art. With this end in view, we have added to the examples of excellence and beauty worthy of imitation,

such also as present errors which ought to be avoided; and as far as space permitted, these instances of faulty and inappropriate decoration have been pointed out in the explanatory text.

Certain large classes of objects, among which were some of the most important and best represented in the Exhibition, did not admit of pictorial illustrations; others did not come properly within the plan of this work; the former have been partially elucidated in the general essays, and both will receive further attention in the DESCRIPTIVE AND ANNOTATED CATALOGUE.

It will be observed, and we desire to call attention to the fact, that many of the essays in the RECORD are employed to explain the condition, methods, and instruments of the United States Coast Survey. It was this part of the New-York Exhibition which was most honorable to our country, as showing our advanced progress in several of the most abstract and difficult departments of human knowledge. The United States may safely rest their claims to be counted among the foremost nations of the world upon what has been already done, and is still doing, for science, for commerce, and for humanity in the Coast Survey.

It is proper to say a word of the engravings themselves, which fill more than half of this volume. The best artists and engravers in this country were employed to execute them; and the greater part have been done to our entire satisfaction. They faithfully represent the present condition and attainments of the art of wood-engraving, and they will not suffer by comparison with similar works executed abroad. In making such a comparison, it must be remembered that the wood-cuts of the RECORD have been wholly printed upon a power-press—a method much less adapted to show their full beauty than the hand-press, but necessary to produce large editions with rapidity.

Our endeavors to make this volume a beautiful and acceptable record of the New-York Exhibition have been always aided by the generous and unhesitating liberality of the publishers, and to them is justly due, and will be awarded, whatever credit may attach to its publication.

Illustrated Record of the Crystal Palace OF ALL NATIONS NEW YORK 1853 EXHIBITION

ARCHITECTURAL PLANS.

AMONG the unaccepted designs for the New-York Industrial Palace, there were some whose architectural merit and beauty claim a place in its history. Upon this page we present the elevation, and upon the fourth page, the interior view of the building designed by Sir Joseph Paxton. The original drawings were generously presented to the New-York Association by their distinguished Author, and the following brief description has been derived from them, and the accompanying memoranda:

The ground plan of the building is a parallelogram; its total area, including the terrace, 24 feet wide, which surrounds it, is about three acres. Its extreme length is 653 feet, and its width 199 feet. Each end has a porched entrance for the convenience of taking up and setting down visitors. The terrace, to be used as a promenade, or for the display of bronze and iron statues and massive mineral specimens, is covered with asphalt, and flanked with a wall of stone, which, at intervals of 26 feet, supports pedestals for lamps. The interior is divided into three compartments — the central nave 600 feet long, and 79 broad, and two side ave-

the arch of the nave. The construction of the flooring, and the drainage of the rain and interior vapors, are the same as was employed in its English predecessor. Great skill has been shown in constructing the galleries, so as not to interfere with the long perspective of the interior. The galleries were not designed for the display of goods, but for promenades. The available space in the building will be observed to be only about one-fourth of that in the plan adopted by the Association, and quite too small for the requirements of the Exhibition.

Should a building hereafter be erected upon this plan, there is no doubt that its effect would be extremely fine. Its noble nave, lofty and free, with its crowning clerestory, designed to accommodate the ventilators, combines with the general simplicity of the plan to give a degree of grandeur to the whole structure, which is conducive to the best architectural effect. It is true, that a great sacrifice of space is made in the exclusion of goods from the galleries; but, on the other hand, it is doubtful whether the same amount of space, if required, may not be more economically gained by an extension of the plan. At Hyde Park the gallery space was gained by a serious loss of beauty in the general proportions of the building. As elsewhere

*** The reader will observe that the *illustrated* pages of the Record are arranged to be read *by themselves*, and follow one another independently of the letter-press, or pages of plain text. Thus, the first, fourth, fifth, and eighth pages are illustrated, and the remainder are text. The convenience of printing the engravings in a separate "form" renders this arrangement necessary in the present number.

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Illustrated Record of the Industry of All Nations

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The framework of this building, like that of its great prototype, the Palace in Hyde Park, is composed of cast-iron columns, connected together by wrought and cast-iron arches and girders, on which rest the wooden arches of the roofs. These, from the supposed necessity of providing against heavy falls of snow, are covered with slate, except the central part of the arch of the nave. With a view, perhaps, to the permanence of the building for successive exhibitions, the basement wall is built of masonry, and the turrets are also of stone. The sides are inclosed with glass, and large and beautiful fan-lights surmount the entrances, and correspond to the arch of the nave. The construction of the flooring, and the drainage of the rain and interior vapors, are the same as was employed in its English predecessor. Great skill has been shown in constructing the galleries, so as not to interfere with the long perspective of the interior. The galleries were not designed for the display of goods, but for promenades. The available space in the building will be observed to be only about one-fourth of that in the plan adopted by the Association, and quite too small for the requirements of the Exhibition.

Should a building hereafter be erected upon this plan, there is no doubt that its effect would be extremely fine. Its noble nave, lofty and free, with its crowning clerestory, designed to accommodate the ventilators, combines with the general simplicity of the plan to give a degree of grandeur to the whole structure, which is conducive to the best architectural effect. It is true, that a great sacrifice of space is made in the exclusion of goods from the galleries; but, on the other hand, it is doubtful whether the same amount of space, if required, may not be more economically gained by an extension of the plan. At Hyde Park the gallery space was gained by a serious loss of beauty in the general proportions of the building. As elsewhere remarked, the square form, and limited dimensions of the plot of ground upon which the New York building has been erected, precluded the use of Sir JOSEPH PAXTON's plans. But the noble disinterestedness with which, at so early a day in the history of the New-York enterprise, the distinguished architect of the London building came forward and presented to the Board of Directors his plans, now under consideration, is worthy of all praise, and will not be soon forgotten.

THE PLAN OF MESSRS. BOGARDUS AND HOPPIN is given in outline upon the fourth page. Its form is circular, forming an amphitheatre 1200 feet in circumference, and designed to cover the whole ground. The entire structure is a multiple of three or four principal parts, any one of which could afterwards be employed in constructing ordinary iron warehouses. The curve is so gentle that no deviation from a straight line was requisite to secure the circular form of the whole am-

[To p. 4.]

DESCRIPTION OF THE BUILDING.

RESERVOIR SQUARE, on which the building of the New-York Industrial Exhibition is erected, lies in the north-western part of the city, four miles distant from the Battery, and three and a quarter from the City Hall, between the Sixth Avenue and the Croton Distributing Reservoir, whose massive walls overshadow its eastern side. The distance from the Reservoir to the Avenue is 445 feet; and the width from Fortieth street in the south to Forty-second street, its northern limit, is 455 feet. This space is almost entirely occupied by the building. The shape of the ground is unfavorable for architectural purposes; and, aside from the facilities of access afforded by the avenue railways and numerous lines of stages, there is nothing to recommend this locality, while the solid and imposing strength of the Reservoir presents an inharmonious contrast with that light and graceful structure which we now proceed to describe.

The appearance of the building and the materials employed to construct it, show its relationship to the Crystal Palace of Hyde Park. Like that, its framework is a system of iron columns and girders; glass excludes the dull and heavy walls of masonry used in ordinary structures, and, with the slender proportions of the framing, gives the edifice the light and airy appearance so well expressed by its popular name. The resemblance which we have spoken of is only a general one; the ground plan, the relative proportion of each of the materials employed, and the details of construction, are quite different from its English prototype, and give it an architectural effect and character of its own.

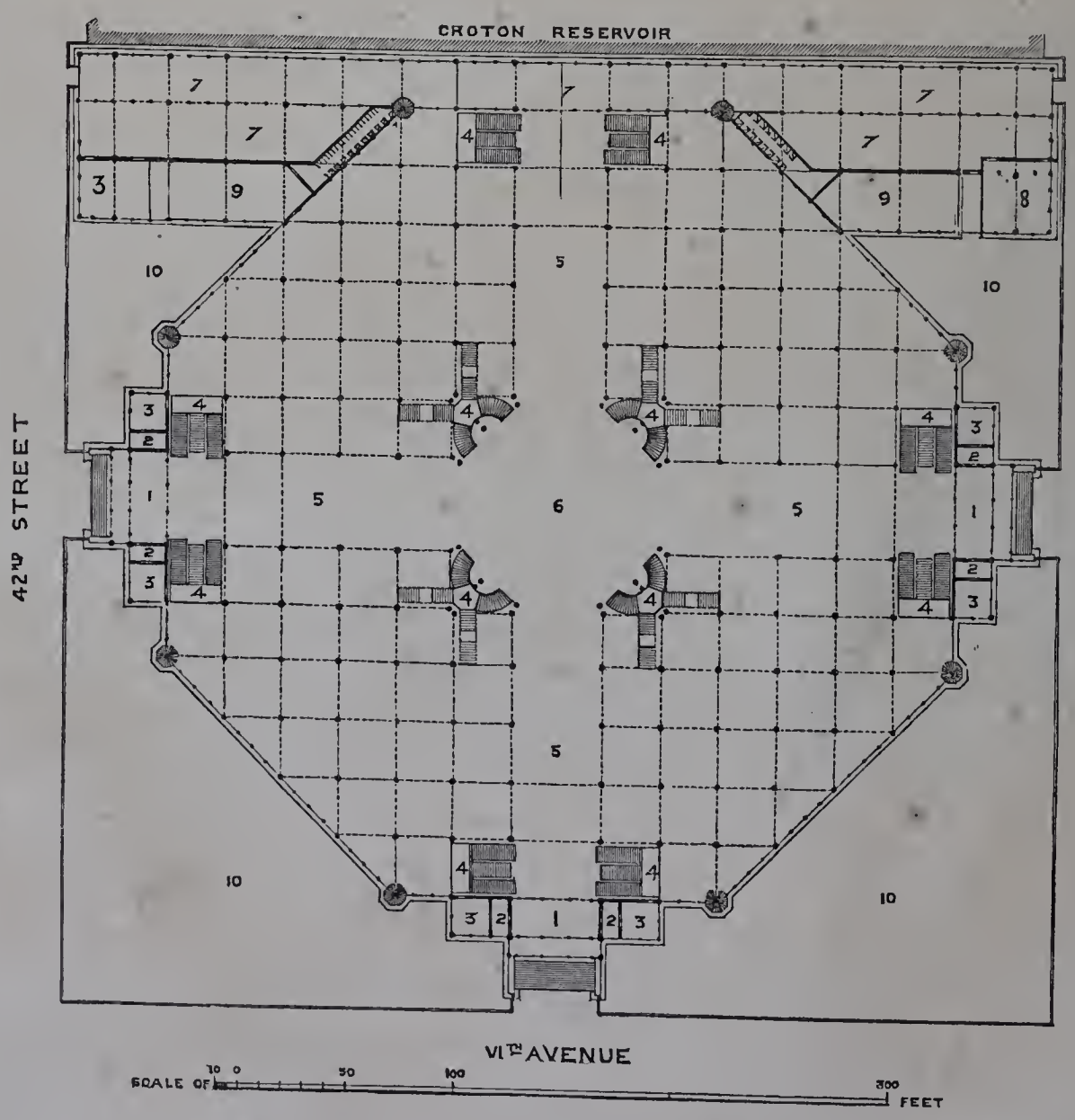
The general idea of the New-York building is a Greek cross, surmounted by a dome at the intersection. The length of each diameter of the cross is 365 feet and 5 inches, and the width of the arms is 149 feet and 5 inches. This does not include the three entrance halls, projecting towards Sixth Avenue, Fortieth, and Forty-second streets, which are each 27 feet wide and approached by flights of steps. By referring to the annexed engravings, it will be seen that, although the edifice is cruciform, the outline of the ground plan is nearly a regular octagon, whose diameter is the same as that of the arms of the cross. This form has been given to it by ingeniously filling up the triangular intervals between the arms of the cross with a lean-to of only one story, or twenty-four feet in height. The adoption of this device was necessary in order to provide space for the exhibition, it being impossible within the narrow limits of the site to enlarge the dimensions of the cross in the usual way; and, while this substantial advantage is gained, it is productive of only a slight architectural defect in diminishing the perspective of the interior.

The arrangement of the columns is represented upon the diagrams. It will be seen that they divide the interior into two principal avenues or naves, each 41 feet and 5 inches wide, with aisles, 54 feet wide, upon either side. The intersection of the naves leaves in the centre a free octagonal space, 100 feet in diameter. The columns still further subdivide the aisles and the triangular intervals between the arms of the cross, into square and half-square compartments, of 27 feet on the side. The aisles are covered with galleries of their own width, and they are united to each other by broad connections at the extremities of the naves. The naves are carried above the roofs of the galleries to admit light, and are spanned by 16 semicircular arches of cast-iron, which are 40 feet and 9 inches in diameter, and placed at a distance of 27 feet from each other.

The number of cast-iron columns upon the ground floor is 190: they are 21 feet high above the floor, octagonal, and 8 inches in diameter; the thickness of the sides varies from half an inch to one inch. The cast-iron girders, 3 feet wide, of which the longest are 26 feet and 4 inches, and those of wrought-iron, 40 feet and 9 inches long, are indicated by the dotted lines. The first tier of girders sustain the floors of the galleries, and brace the structure in all directions. They are united to the columns by connecting pieces 3 feet 4 inches high, which have the same octagonal shape as the columns, and flanges and lugs to be bolted together. The number of girders in the first tier is 252. The second story contains 148 columns, 17 feet and 7 inches high, which rest on those below them, and have the same shape. They receive a second series of girders numbering 160, which support the roofs of the aisles. They also receive the semicircular arches of the naves. All the roofs are supported upon arches or upon girders by means of wrought-iron inverted trusses which receive the angle iron purlins of the rafters; the latter are made of strips of wood inclosed between iron sides. The roofs are uniformly constructed of boards matched together, and covered with tin.

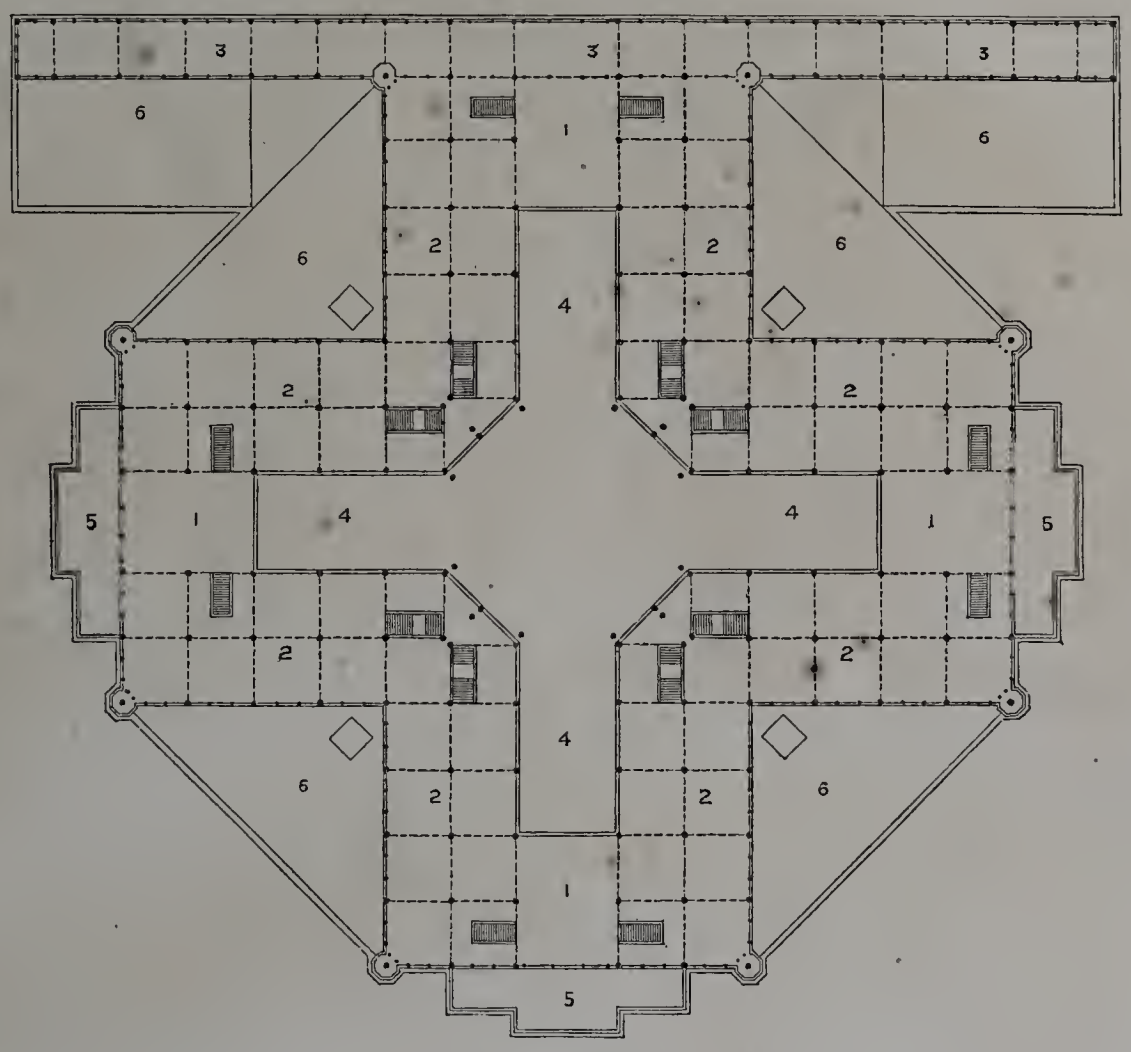
The dome, noble and beautiful in its proportions, is the chief architectural feature of the building. Its diameter is 100 feet, and its height to the springing line is nearly 70 feet, and to the crown of the arch 123 feet. It is the largest, as well as almost the only dome hitherto erected in the United States. To our untravelled countrymen it may be an instructive example of the beauty and fine architectural effect of which this structure is capable, although its dimensions are trivial when compared with the majestic domes of the Pantheon or St. Peter's, or those other wonderful erections of classic and mediæval times when architecture was a passion, and united with religious enthusiasm to produce the triumphs of the Art. We have given upon a separate page, as a frontispiece of this number, an architectural section of the dome, which will give our readers a better idea of its structure than any description can do. A perspective view of the interior, which was promised by the architects for this number, will be published as soon as it is ready. The dome is supported by 24 columns, which rise beyond the second story, and to a height of 62 feet above the principal floor. The system of wrought-iron trusses which connects them together at the top, and is supported by them, forms two concentric polygons, each of 16 sides. They receive a cast-iron bed-plate to which the cast-iron shoes for the ribs of the dome are bolted. The latter are 32 in number. They are constructed of two curves of double angle-iron, securely connected together by trellis-work. The requisite steadiness is secured by tie-rods, which brace them both vertically and horizontally. At the top, the ribs are bolted to a horizontal ring of wrought and cast-iron, which has a diameter of 20 feet in the clear, and is surmounted by the lantern. As in the other roofs of the building, the dome is cased with matched deal and tin sheathing. Light is communicated to the interior through the lantern, and also in part from the sides, which are pierced for 32 ornamental windows. These are glazed with stained glass, representing the arms of the Union and of its several States, and form no inconsiderable part of the interior decoration.

The external walls of the building are con-



GROUND PLAN.

structed of cast-iron framing and panel work, into which are inserted the sashes of the windows and the louvres for ventilation. The glass is one-eighth of an inch thick, and was manufactured at the Jackson Glass Works, N. Y., and afterwards enamelled by Cooper & Belcher, of Camptown, N. J. The enamel, with which the whole of it is covered, is laid upon the glass with a brush, and after drying, is subjected to the intense heat of a kiln, by which the coating is vitrified, and rendered as durable as the glass itself. It produces an effect similar to that of ground glass, being translucent, but not transparent. The sun's rays, diffused by passing through it, yield an agreeable light, and are deprived of that intensity of heat and glare which belongs to them in this climate. In the absence of a similar precaution in the Crystal Palace of Hyde Park, whose roofs as well as walls were inclosed with transparent glass, it was found necessary to cover the interior of the building with canvas, to produce the required shade.



PLAN OF THE GALLERY.

At each angle of the building there is an octagonal tower, 8 feet in diameter and 76 feet in height. These contain winding stairways which lead to the galleries and roofs, and are intended for the use of the officers and employées of the Association. Twelve broad staircases, one on either side of each entrance, and four beneath the dome, connect the principal floor with the gallery. The latter are circular in part, and consist of two flights of steps with two landing places. The flooring of the galleries is made of closely matched planks, while those forming the floor of the first story are separated by narrow intervals, in the same manner and for the same purpose as in the London building. Over each of the principal entrance halls, the galleries open upon balconies, which afford ample space for placing flowers, vases, and statues for decoration. Above the balconies, the ends of the naves are adorned with large fan-lights, corresponding to the semicircular arches within. On each side of the entrances there are ticket offices, and adjacent to them rooms are provided for the officers of the Association, telegraph, &c.

The rapid and unexpected increase of the applications of exhibitors induced the Association to erect a large addition to the building already described. It consists of two parts, of one and two stories respectively, and occupies the entire space between the main building and the reservoir. Its length is 451 feet and 5 inches, and its extreme width is 75 feet. It is designed for the reception of machinery in motion, the cabinets of mining and mineralogy, and the refreshment rooms with their necessary offices. The second story, which is nearly 450 feet long, 21 feet wide, and extends the whole length, is entirely devoted to the exhibition of pictures and statuary. It is lighted from a sky-light, 419 feet long, and 8 feet and 6 inches wide.

The Decorations of the building have been intrusted to Henry Greenough, Esq., of Cambridge, brother of the lamented sculptor of the same name. Mr. Greenough has made Art his study, and in its pursuit has resided long in Italy. As he has promised to unfold the general principles and detail of his present work in an essay to be published in an early number of the Record, we will state at present only a few facts.

The leading idea in the plan of decoration has been to bring out the beautiful construction of the building—to decorate construction rather than to construct decoration. To do this, and at the same time to preserve a general harmony of effect, has given Mr. Greenough ample opportunity to display his knowledge of the resources of his art. The result is surprisingly beautiful.

The decoration was commenced only on the 27th of April, but as soon as the progress of the construction would permit. The colors employed on the exterior and interior are mixed in oil, the base being the white lead manufactured by the Belleville Co. The exterior presents the appearance of a building constructed of a light-colored bronze, of which, all features purely ornamental are of gold.

The interior has a prevailing tone of buff, or rich cream-color, which is given to all the cast-iron constructive work. This color is relieved by a moderate and judicious use of the three positive colors, red, blue, and yellow, in their several tints of vermilion, garnet, sky blue and orange, (certain parts of the ornamental work being gilt) to accord with the arrangement of colors employed in the decoration of the ceilings. The only exceptions to the use of oil colors are the ceiling of the American lean-to and the dome; these decorations are executed in tempera on canvas.

The effect of the interior of the dome, (designed by Sr. Monte Lilla,) is particularly splendid. The rays from a golden sun, at the centre, descend between the latticed ribs, and arabesques of white and blue, relieved by silver stars, surround the openings. We propose hereafter to furnish a page in chromo-lithography, which will illustrate in a much more satisfactory manner than can be accomplished by description, the arrangement and effect of the interior decoration. But, as already stated, a more extended account of the decorations, explaining the principles on which they are designed and the objects in view, will appear in the report of the Superintendent of Decoration.

The building is supplied with gas and water in every part. The gas is designed for the use of the police in protecting the property by night, but is so arranged, that should it be deemed expedient to open the building in the evenings there will be ample light. The water is accessible at numerous points, with conveniences for drinking, and also for the attachment of hose in case of fire.

The whole quantity of iron employed in the construction amounts to 1,800 tons; of which 300 tons are wrought, and 1,500 tons cast-iron. The quantity of glass is 15,000 panes, or 55,000 square feet. The quantity of wood used amounts to 750,000 feet, board measure.

To complete our explanation of the construction of the building, we recapitulate its principal dimensions, and annex a few references to the diagrams:—

PRINCIPAL DIMENSIONS.

	FT.	IN.
From principal Floor to Gallery Floor,	24	
" " " to top of 2d tier of Girders,	44	4⅜
" " " to top of 3d " "	59	10
" " " to ridge of Nave	67	4
" " " to top of Bed-plate,	69	11
" " " to top of upper ring of Dome,	123	6
" 6th Avenue curb-stone to top of Lantern,	151	
" " " to top of Towers,	76	9
Area of first floor,	157,195 sq. feet.	
" 2d "	92,496 " "	
Total area,	249,692 or 5¾ acres.	

REFERENCES TO GROUND PLAN.

1. Entrance Halls.
2. Ticket Offices.
3. Rooms for Officers.
4. Staircases to Galleries.
5. Principal Avenues or Naves.
6. Central Space beneath the Dome.
7. Machinery in Motion.
8. Mineralogical Department.
9. Refreshment Rooms.
10. Flower Garden, &c.

REFERENCES TO GALLERY PLAN.

1. Connections of the Galleries.
2. Galleries.
3. Picture Gallery.
4. Open Nave.
5. Balcony over Porches.
6. Roofs.

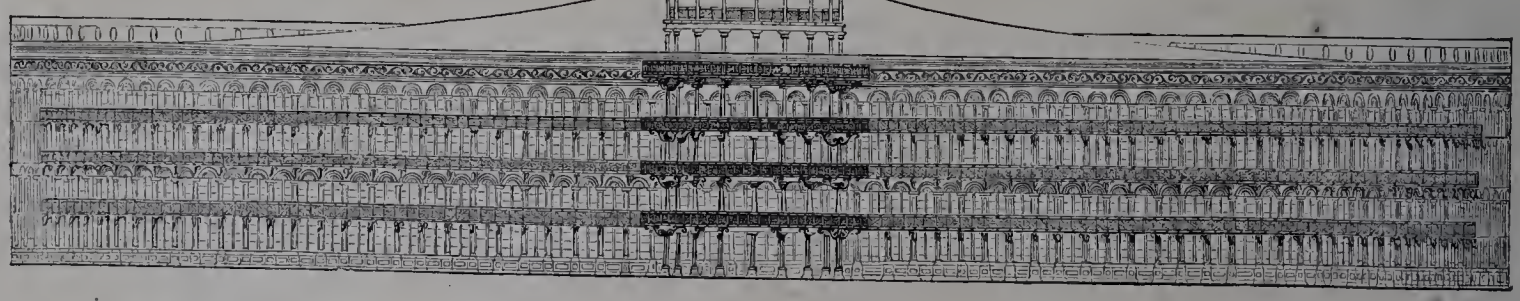
[From p. 1.]

phitheatre. The plan was recommended by its economy, the parties offering to put up the whole building for the sum of two hundred thousand dollars. The tower in the centre was to serve the double purpose of a support for the hanging roof of sheet-iron suspended from it by rods in a catenary curve, and also as a grand observatory. For this end it was to be 300 feet high, and provided with a mechanism for hoisting observers to the top by steam power. The height of the exterior wall is about 60 feet. The proprietors, who are largely concerned in the erection of cast-iron houses, expressed a conviction that the whole structure would be worth very considerably more when dissected, for ordinary purposes, than in its present form, owing to the economy obtained in reproducing so large a number of identical parts from the same patterns.

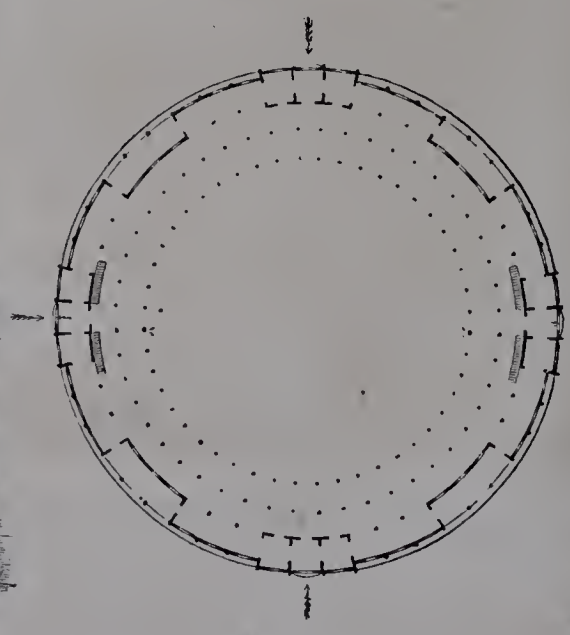
The late A. J. Downing also presented for the consideration of the Association a plan of great novelty and bold conception. We are indebted to the kindness of Calvert Vaux, Esq., of Newburgh, for drawings of the exterior and interior views, and the ground plan of this design, and with them we conclude the fourth page of this number.

The ground plan is a circle intended to occupy the whole of Reservoir Square, and to be surmounted by a colossal dome, built of wood and canvas, with supporting columns of iron. The dome was proposed to be constructed with thin curved ribs, placed at short distances, secured with angle iron, and notched into circular ties made of several firmly bolted thicknesses of two-inch plank. The stability of the dome depends upon the ties, which do away with the difficulty of thrust, and leave the weight only of the materials to be supported. The combined strength and lightness of this mode of construction is seen in an eggshell, whose double dome of lime is furnished with an uninterrupted tie in the interior by its tough membranous lining.

The canvas, lining the interior, is designed to be of pearl-gray color at the springing line, gradually deepening into an intense blue at the crown. The external ribs, being covered with tin and glass tiles, would produce an effect similar to that of silvering. As this dome would require no centering, and but little scaffolding, its construction would be both easy and economical. The general aim has been to make the interior light and airy, and to give unity of character to the design, by avoiding smallness of parts, and arranging in such a manner that it may be conspicuous at a distance and adapted to its position.

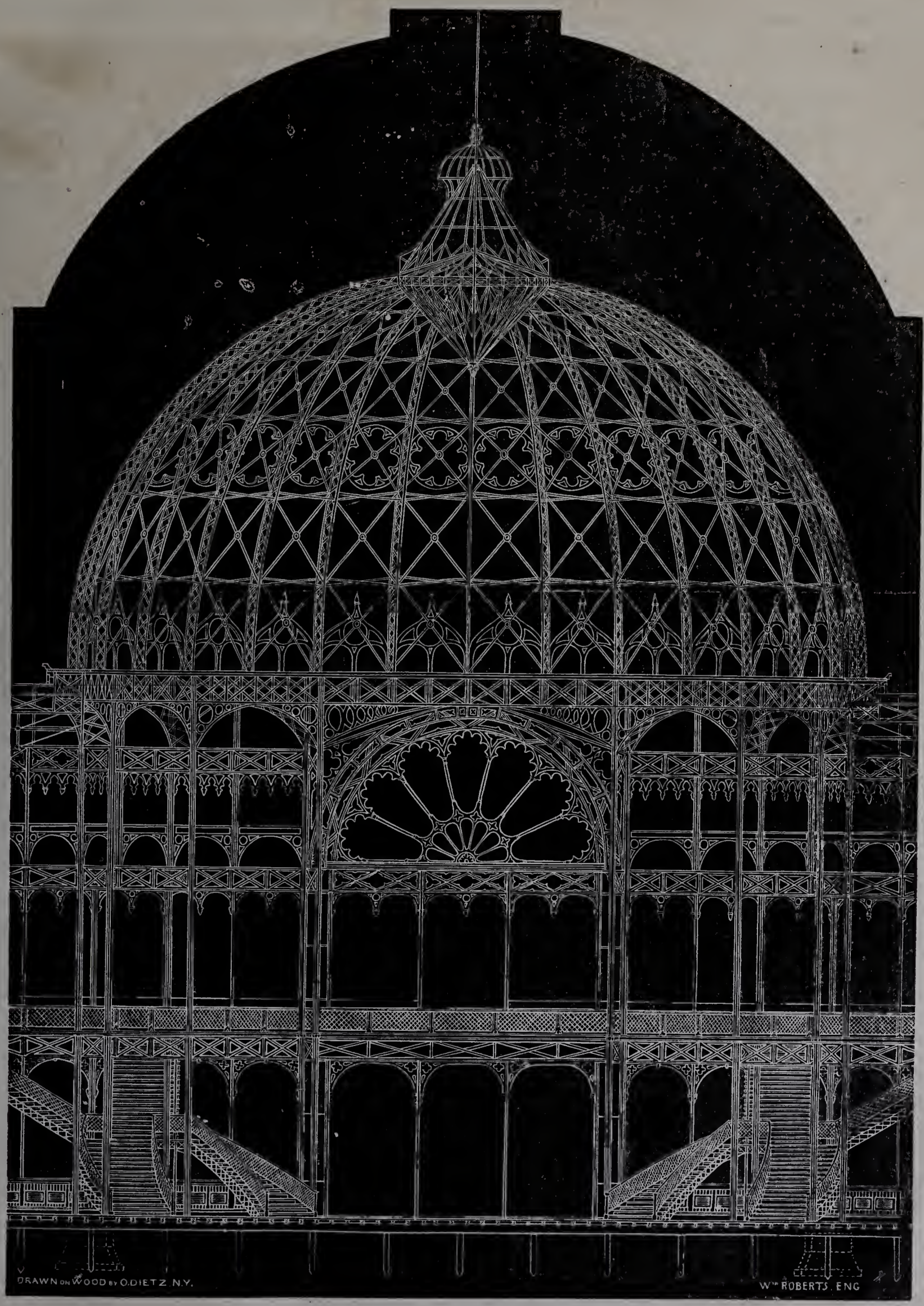


ELEVATION



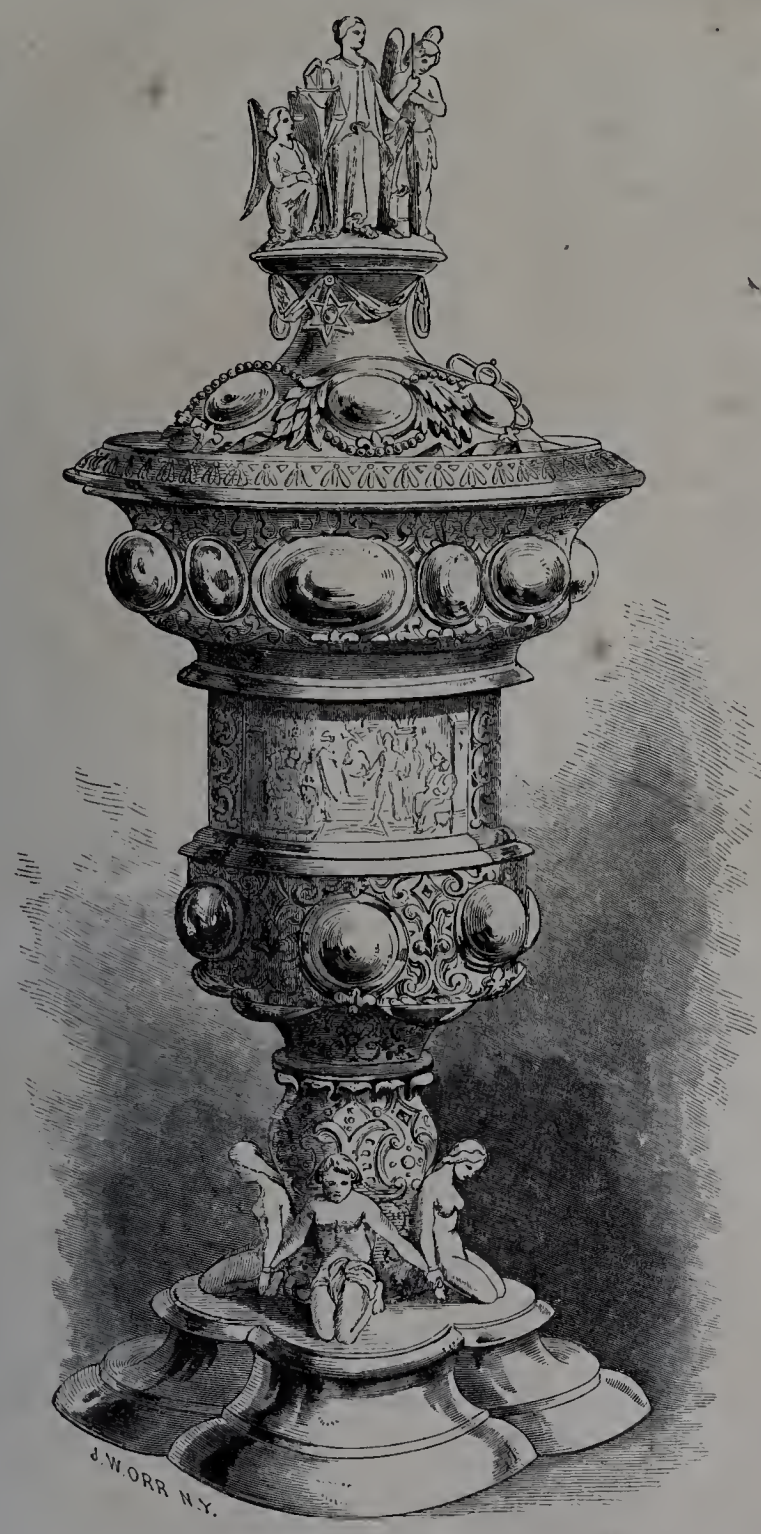
GROUND PLAN.

SECTION.



NEW-YORK CRYSTAL PALACE.—SECTION OF THE DOME.

ILLUSTRATIONS OF OBJECTS EXHIBITED.



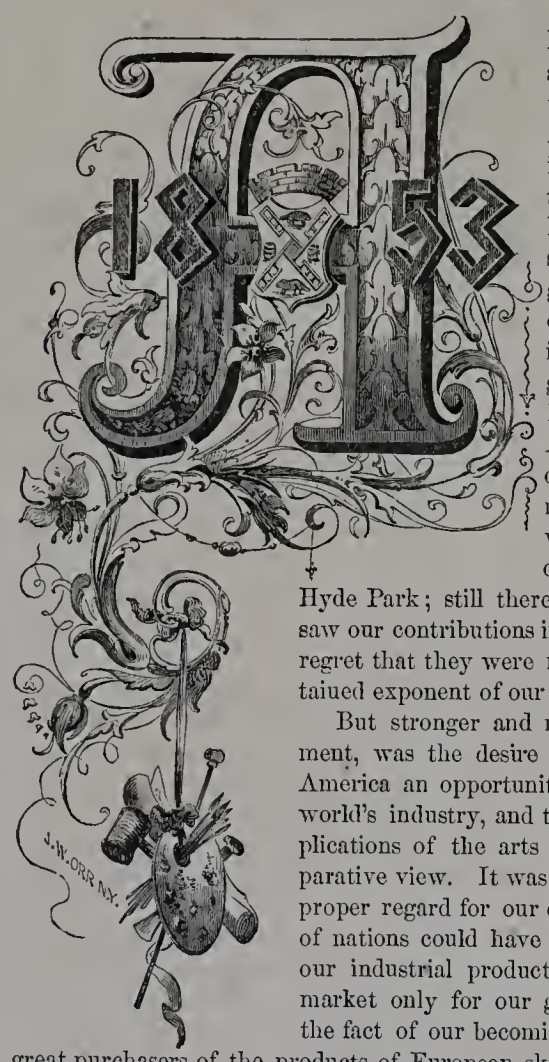
The Swiney Cup—a prize offered by the Society of Arts for the best treatise on Jurisprudence published before the close of the present year, and open to the competition of all nations, is exhibited by the Council of the Society. The goblet is silver, about fourteen inches high, and was executed by Messrs. Garrard from the designs of D. Maclise, R. A.

An Epergne, electro-plated on German silver, is exhibited by T. Sharpe, London. The design is a beautiful female supporting a cornucopia, from which rises a basket of intertwining vines with grapes.

The Sleeping Child is a statue in marble, designed, executed and exhibited by Signor Piatti, of New-York, the Superintendent of the Sculpture department of the Exhibition.

INTRODUCTORY.

HISTORICAL.



A BRIEF statement of the origin and progress of the Association for the Exhibition of the Industry of All Nations, will be an appropriate introduction to the first part of the RECORD. It is perhaps needless to say that the triumphant success of the London Exhibition gave birth and force to the idea of this. Simultaneously, almost, it was proposed to repeat the grand experiment in Dublin, in France, and in the United States. Although America achieved some of the most signal and permanently valuable results which were brought to the knowledge of mankind by the Exhibition in Hyde Park; still there was probably no American who saw our contributions in London, and did not feel some regret that they were not a more just and equally sustained exponent of our resources, industry, and arts.

But stronger and more controlling than this sentiment, was the desire excited to afford the masses in America an opportunity to see the grand total of the world's industry, and the manifold productions and applications of the arts of design brought in one comparative view. It was seen that while no motive but a proper regard for our own position in the great family of nations could have induced us, as a people, to send our industrial products to Europe, where we find a market only for our great staple raw materials, that the fact of our becoming more and more every day the great purchasers of the products of European skill and labor, expended, perhaps, upon our own products, would induce all the manufacturing states of the old world to embrace, eagerly, an opportunity to expose their products in the New-York Crystal Palace.

This conviction, strengthened by the sentiments before alluded to, led a few public-spirited citizens of the United States, early in 1852, to contemplate the organization of the effort whose results we see. It was not designed or desired to reproduce the London Exhibition, which, from the very nature of the case, must ever remain unexampled; but to draw forth such a representation of the world's industry and resources as would enable us to measure the strength and value of our own, while it indicated new aims for our enterprise and skill.

There is no humiliation in the acknowledgment, that America has more to gain from such a comparison than any other nation in Christendom—and we believe she is also more willing to avail herself of the suggestions it offers.

It was obvious in the outset, that numerous difficulties would embarrass the successful organization of an exhibition of industry in the United States, which should at once be universal in its scope, and devoid of the imputation of local or sectional influence. These difficulties were inherent in the nature of our political institutions.

In England, the suggestion of Prince ALBERT to the Society of Arts was received with enthusiasm, and enlisted not only the cordial support of the Queen, but every member of a numerous and wealthy aristocracy joined his hand in setting forward the royal project. The government, however backward and lukewarm they might have been at first, could not resist an influence with which, as men, they were identified. Then the almost supreme power of the London journals came in to swell and direct the popular sentiment, and to make every Englishman feel that he had an immediate personal stake in the success—the triumphant and overwhelming success—of an enterprise to which the honor of his sovereign, and of the nation, stood pledged before all mankind.

Under the stimulus of such powerful motives, the universal intellect of the United Kingdom organized itself in Councils, Committees, and Juries. Men whose names are identified with the halls of science, of literature, and of art, left their tripods, and were found heading the various corps of hard-working volunteers in considering or perfecting the several details of the colossal scheme. The rooms of the Royal, the Geological, the Geographical, the Ethnological, and the Statistical Societies, of the Institutions of Civil Engineers and Architects, of the Museum of Economic Geology—and even of the staid and conservative Universities, were for a time deserted to furnish men and mind for the emergency. In looking over the long catalogue of councilmen and chairmen, of commissioners, associates, and jurymen, whose names are connected with the administration of the London Exhibition, it is astonishing to see what an array of talent and learning was gathered to secure its success. Nor was this peculiar to Great Britain; but from all parts of the world, we find in its published lists men whose names are the guaranty of eminent success, not only in their own departments, but in whatever they may undertake. Such was the animus of the London Exhibition.

Compared with this royal espousal, and enormous personal influence brought to sustain and carry forward the exhibition of 1851, the simple machinery and resources of an association of private gentlemen, however enterprising, might seem utterly inadequate. Let the results decide. Such an association was formed, and stands committed to the successful prosecution of the plan. All the world has been invited to co-operate in sustaining the effort, and the appeal has met a response as cordial, as the design is liberal and catholic.

New-York was selected as the locality of the Exhibition, because of its great advantages as a commercial centre, and as the chief entrepôt of European goods. Had it been proposed to limit the Exhibition to the products of American industry, some place more central, as Washington, Philadelphia, or Cincinnati, might have been justly preferred, but in view of the foreign department of the scheme, New-York seemed the only place at all suited for the purpose.

The municipal authorities of the city of New-York, on the 3d of January, 1852, moved by an enlightened regard for the prosperity of the city, and the interests of its inhabitants, granted a lease for five years of Reservoir Square, for this purpose, upon two conditions: one, that the building should be constructed of glass and iron, and the other, that no single entrance fee should exceed fifty cents.

The Legislature of the State of New-York, upon application, granted, on the 11th of March, 1852, the charter under which the ASSOCIATION FOR THE EXHIBITION OF THE INDUSTRY OF ALL NATIONS has been organized and carried forward. The Act clothed the Directors with all the powers needed to carry out its plans, and the Legislature have since that time extended its privileges, so that it can issue stock to the amount of half a million dollars, in place of the original limitation to three hundred thousand dollars. The Board of Directors first met on the 17th of March, 1852, and organized by the election of THEODORE SEDGWICK, Esq., President, and WILLIAM WHETTEN, Esq., as Secretary. No time was lost in publishing and circulating a general statement of the objects of the enterprise. A call for subscriptions to the stock was met in due time by about one hundred and fifty persons and firms coming forward to take up the first two hundred thousand dollars. This wide distribution of the interest in a large number of hands completely avoided the obnoxious charge, that the undertaking was a speculation designed for the benefit of a few.

The countenance and co-operation of the general government was sought with a view to the introduction of foreign goods into the Exhibition duty free. And official assurances were given by Mr. MAXWELL, the Collector of the port of New-York, that the building of the Association would be made a bonded warehouse, thus entitling the Association to receive the goods free of duty, while on exhibition.

The influence of the general government was also most cheerfully extended on behalf of the Association through the kind offices of Mr. WEBSTER, then Secretary of State, who wrote to the representatives of the United States at the principal courts of Europe, stating to them his sense of the importance of the enterprise, and the numerous reasons why in his view they should give to the Association all the aid and support in their power.

The Ministers of foreign powers, resident in the United States, had previously responded, in terms of entire cordiality, to the general circular of the Association, which had been addressed to them, stating its plans, and soliciting the co-operation of European nations. They all expressed their convictions that their respective governments would look with favor upon the proposed exposition, and unite in sending to New-York their most valued and characteristic objects of industry.

The leading foreign newspapers also manifested a most friendly desire to sustain the success of the undertaking, and the records of the office contain the most abundant evidence of their zealous support; while the daily journals in foreign languages in the United States were prominent in lending their services to the cause.

The organization of the foreign relations of the Association was effected by the appointment of Mr. CHARLES BUSCHEK, of London, as its general agent, through whom all details have been arranged. This delicate and important trust, involving the greatest responsibility, required talents, knowledge, and experience, both of a commercial and of a diplomatic character. The Association was truly fortunate in finding these qualities combined in one person. Mr. BUSCHEK was the Austrian Commissioner at the London Exhibition of 1851, and through him the co-operation of the European manufacturers has been secured to an unexpected extent.

At a later period in the history of the enterprise, it was thought to be expedient to send out to Europe Col. G. W. HUGHES, of Maryland, to co-operate with Mr. BUSCHEK in carrying out the plans of the Association. This gentleman added to the weight of his official commission the influence of personal qualities, fitting him,

in a remarkable manner, for his delicate task of soliciting or directing the countenance and support of European governments in favor of the objects of the New-York Exhibition. The result of his labors has been the securing from various governments important contributions, which would otherwise have remained unknown in the UNITED STATES.

By midsummer of last year, the corps of engineers and architects was organized by the appointment of Mr. C. E. DETMOLD as superintending architect and engineer; Mr. HORATIO ALLEN, consulting engineer; and Mr. EDMUND HURRY, consulting Architect. To these gentlemen the construction of the building was confided, and by them it has been brought to its completion.

THE BUILDING.

Meanwhile proper steps were taken to secure a plan for the building. The peculiar form of the ground, and the comparative want of experience, on the part of manufacturers, engineers, and architects in our country, in the matter of iron construction, were among the prominent difficulties presenting themselves at the outset, and offering serious obstacles to the movements of the Association. We mention, with peculiar pleasure, that Sir JOSEPH PAXTON, of Chatsworth, at an early stage of the proceedings, (December, 1851,) in the most liberal manner, sent out for the free use of the Association a plan for a building of great beauty and simplicity, accompanied by specifications. These designs we have the satisfaction of presenting in this number of the RECORD, as copied from the original drawings in possession of the Association. Unfortunately, the shape of the ground selected for the New-York Exhibition, rendered it impossible to consider the propriety of adopting them.

We take a melancholy pleasure in referring also to the plan proposed by that gifted and most lamented man, ANDREW J. DOWNING, whose memory is sweetly embalmed in the affections of his countrymen. This plan contemplated the large use of wood and canvas as a part of the materials of construction, while by the terms of the charter of the Association, iron and glass were to be principally employed. Mr. Downing's design was therefore precluded, but we are enabled by the kindness of Mr. Vaux, the business partner of Mr. Downing, to present an engraving of it to our readers, accompanied by such explanations as will render it intelligible.

Several other plans, characterized by boldness, originality, or ingenuity, or all combined, were presented for consideration, and some of them, with the consent of their authors, we may hereafter present in our columns. One of them, that of Messrs. BOGARDUS & HOPPIN, is given upon page fifth.

After much consideration, and a careful comparison of the various advantages of the several plans brought under the notice of the board, it was finally decided, on the 26th of August, to adopt the plan proposed by Messrs. CARSTENSEN & GILDEMEISTER, and immediate steps were taken to secure its construction.

The details of the construction of the building will be found in connection with the designs which are given elsewhere in the RECORD. The original plan has been increased nearly one-fourth by the addition of a new building for the machinery, making the total area for exhibition over two hundred thousand square feet, or about five acres, and still the complaint most likely to be made is, that the building is too small. The mechanical execution of the iron work reflects the highest credit on the skill of the mechanics who have wrought it, and proves the feasibility of applying this mode of architecture in the United States for ordinary purposes. The use of cast-iron had, however, already become common here for warehouses, to a degree exceeding even its use elsewhere, until a very recent period; and its superiority in such constructions over stone in the very important requisites of lightness and strength, will insure its continued employment wherever these qualities are to be combined.

EXECUTIVE DEPARTMENT OF THE EXHIBITION.

The sole charge of the interior of the building, as respects its administration, its division, arrangements, classifications and police, has been confided, with the sanction of the Government, to two officers of the United States Navy, Captains S. F. DUPONT and CHARLES H. DAVIS.

These gentlemen, who have so much distinguished themselves in the special services in which they have been employed, have organized their department by the following appointments:

J. M. BATCHELDER, Secretary of the Superintendents.
SAMUEL WEBBER, Arrangement of Space and Classification.
Prof. B. SILLIMAN, Jr., Mineralogy and Chemistry.
B. P. JOHNSON, Agricultural Implements.
EDWARD VINCENT, Textile Fabrics.
FELIX PIATTI, Sculpture.

Two-thirds of the space has been devoted to foreign nations, and the remaining third to the United States. This third occupies the northeastern quarter of the building. The machinery is placed in an arcade running the whole length of the eastern side of the plot of ground, and the power required for the machinery in motion, is derived from two steam-engines, whose boilers are placed in a separate house upon the opposite side of Forty-Second street. The steam is brought under ground in iron pipes insulated by non-conducting materials. The details of the subdivision will be observed upon the plans which accompany the present number.

The classification adopted is substantially the same as that used in London, with a few changes and subdivisions suggested by experience; and the rules regarding the interior police of the building, the conduct of exhibitors, and the custody of valuables, are also, for the most part, the same as in London.

The terms upon which contributions are admitted into the building are extremely liberal. The freight is paid by the ASSOCIATION both to and from America, upon all articles from foreign countries, whenever the objects exhibited are to be returned. The American contributors pay their own freights; but the ASSOCIATION covers the whole contents of the building by an insurance against fire, free of charge to all.

RAW MATERIAL.

The MINERALOGICAL and MINING department occupies a distinct apartment in the new portion of the building, and owing to the backwardness of this part of the construction, can hardly be opened as soon as the main building. The plan adopted by the Director of this department, has been to obtain as far as possible, in the time allowed, representations from every important mine and locality within reach; and to arrange the specimens with reference to their geographical distribution, so that the collection will, in some degree, at least, be a mineralogical map of the country. To make such a collection in all respects complete, would, of course, demand the labor of many years. But to insure a somewhat competent representation of the resources of the United States, in this department of her raw materials, special agents have been sent to visit the various mines, furnaces, smelting works, and mineral localities, with instructions to obtain characteristic specimens from the most authentic sources. The resources of private cabinets have also been taxed, and in most cases a truly liberal spirit has shown itself on the part of proprietors in loaning their most valuable minerals for the use of the Exhibition. The same may be said of some of our public collections. From foreign countries also there have been received valuable collections in this department.

From many parts of the United States and of Canada, raw materials will form the chief bulk of the contributions. These will consist, of course, of those objects for which each State, territory, or province, is most noted; of the metals, valuable minerals, building materials, agricultural productions, and all the various products of the sea, the rivers, and the forest.

MECHANICAL DEPARTMENT.

CONTRIVANCES for the saving of human labor, will be found to afford much material for attentive study in the MECHANICAL DEPARTMENT of the Exhibition. In America, the high price of human labor has led to the invention of much curious and useful machinery, to perform the duties assigned in the old world to manual skill. Such machines are common enough, certainly, in all manufacturing countries; but we believe it is safe to say, that they are more numerous and of more various application in the United States than elsewhere. Numerous examples in support of the truth of this observation will be found in the Exhibition. A single instance that occurs on the instant will illustrate it. There are not less than ten machines exhibited for sewing cloth or leather, and all by different American inventors (how many European ones there may be, we have not ascertained). Some of them employ a double and some a single thread, and some are fitted for special uses. But all are designed to substitute the strength and precision of machinery for the delicate fingers of a woman. One of these machines, it is said, may easily perform the work of ten women in a day. It is worth while to remember, that in the London Exhibition there were only three machines of this sort, one from France (SENECHAL'S, for sewing sacks); one from America (Blodgett's); and one from England (Judkins's). We shall take an early opportunity of discussing this subject more at length.

Nor will we omit to mention in this connection, the Cotton Gin of WHITNEY, certainly not a new invention, but not the less a corner-stone of American industry. This peculiarly national invention is represented in the present Exhibition by the original model, constructed in 1793 by the hands of its inventor, and exhibited by his son, ELI WHITNEY, Esq., of New Haven. No one can fail to view, without deep interest, this simple apparatus, when he reflects that the greatest branch of American agricultural industry dates its origin from the day when the planter received this result of WHITNEY'S genius; that no important addition or improvement was ever made upon it; and that without its efficient aid in cleaning the cotton from its seeds, this new colossal product might have still remained undeveloped.

Startling to GUTTEMBERG and FAUST would be the almost incredible rapidity of the POWER PRESSES of our day. Although we have little to say of improvement in paper and typography, over the Mazarin Bible, it is certainly true,

We commence the illustrations of this page with three subjects in Parian from the prolific manufactory of Alderman Copeland. The central engraving represents the Return from the Vintage. This group, twenty-six inches in height, and consisting of seven figures, is modelled from the original, late in the possession of the Earl of Litchfield. The festivity, which it commemorates, is too well known to require description here. The figure on the right, called a Sitting Cupid, supports a basket for the reception of flowers. The corresponding one on the left is also a Cupid, and represents him in another, and possibly less harmless character, silent, and meditating one of those stratagems which are ascribed to the agency of the Boy-god.

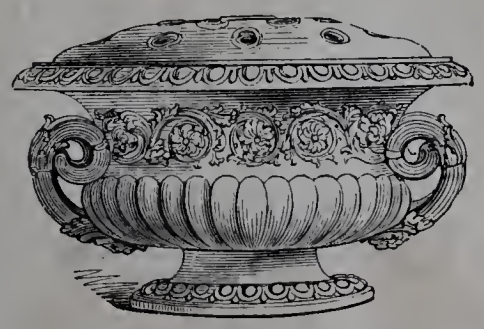
We adorn our page with a new engraving of the famous group by Kiss, of Berlin—an Amazon on horseback attacked by a tiger. The artist represents the critical moment of the action with wonderful skill and effect. The tiger has already fastened his fangs and claws deep in the neck of the struggling horse, while the rider, throwing herself back out of her ordinary seat, poises her spear to transfix the monster with a single and decisive blow. The countenance of the Amazon expresses terror at the sudden attack of the tiger, but her courage does not falter, and the spectator feels, that of the two barbarians, she is the mightiest and most vengeful.

The group exhibited, a copy of the colossal bronze original which adorns the entrance of the Royal Museum at Berlin, was cast in zinc at the foundry of Geiss, and illustrates the perfection of casting and chiselling, as well as the durability and cheapness, which combine to recommend this metal to the statuary. Copper is deposited on the zinc by galvanic action, and thus produces a bronze surface as beautiful and durable as the costlier metal. It is hazardous to criticise a work which has received the almost universal applause of the world. In sculpture the unity of the action, where there is action, the individuality and simplicity of the sentiment, where there is repose, ought ever to be the thing foremost in the work. Such was the invariable habit of the great masters of Grecian art, from whose authority there is no appeal. The moment the action becomes complicated by the introduction of any element distracting the mind from what should be single and undivided—the unity—that instant the sculptor passes into the province of the painter, and should give his work the form of a bas-relief. Here we see distinctly two actions, the Amazon and the tiger; the tiger and the horse. It is nobly done; the anatomy, the sentiment, all express entirely the artist's design, and within the limits of pure expression, free from extravagance. But the design is pictorial, not sculpturesque. The Laocoon is a noble instance of unity consistent with the use of agonizing action of several figures, and the savage reptiles. The just retribution of a flagrant crime—the wrath of the gods symbolized in the coils of the snakes—the despair and torture of the damned, in the distorted features and writhing bodies of the victims, all conspire to produce unity out of complexity, and teach the high moral lesson of the supremacy of virtue, and sure punishment of transgression. Compared with this standard of Art, it is plain that Kiss's Amazon, fine as it is, holds a secondary place.

To those who know the power of Art to educate and refine the taste, the social life and character of a people, it has always been a cause of regret that the appreciation and enjoyment of it should have been confined to the few whose wealth was equal to the purchase of its costly productions. For this reason, works of high Art have been almost unknown in this country and in Europe, they have been the exclusive possession of national galleries, or of an hereditary aristocracy. Neither the middle nor the lower classes have been brought under its influences. It has never developed among the majority of any people that love of beauty and symmetry, native in every one however rude and unrefined; it has not brought the passions of mankind under its control, and therefore has not yet accomplished its destined purpose as a means of civilization. We believe that Art is capable of accomplishing all that is claimed for it by its most enthusiastic friends, when our life in all its pursuits is brought into daily contact with its productions; when its works are no longer a monopoly, but an every-day possession, within the reach of the mechanic and tradesman as well as the opulent and noble. If the beautiful were daily placed before us, surely our social life could not fail to be ameliorated and exalted by its silent eloquence.

We would not confine the influence of Art to works purely ornamental, to statues, vases, and pictures. The rudest household furniture, the ordinary serviee for the table, and the houses themselves may possess artistic and symmetrical beauty, and be none the less useful. We are not convinced by the homely reasoning attributed to Socrates, that whatever is useful is therefore beautiful. Such sentiments, which have too widely prevailed, in our own country, especially we are glad to believe, are yielding to a

[To p. 12.]



that in the facility of every mechanical detail, the rapidity and precision with which books of high average quality are now manufactured (we use the word literally), is such as to form an era in the world's progress. We will not anticipate what we have to say elsewhere, and in more detail, upon the interesting subject of typography, but will simply add that this RECORD is printed upon two power presses, in the building of the Exhibition, moved by steam power supplied from the engines, whose duty it is to drive the machinery of the mechanical department. Thousands of visitors will thus be able to see, probably for the first time, the rapid movements of these seemingly intelligent operatives, whose one sole requirement appears to be an insatiable appetite for fair white paper. The illustrations are printed upon the press of ISAAC ADAMS & Co., of Boston, while the letterpress side is worked upon that of A. B. TAYLOR & Co., New-York.

FINE ARTS.

It is encouraging to mark the great progress made in the United States during the last ten years, in the general appreciation and patronage of the various Arts of Design, including Architecture. The public mind is now somewhat impressed with the importance of these subjects, and is moving in the right direction. It needs, however, constant watchfulness to guard against the errors growing out of a tendency to admire what is overwrought or extravagant, and to substitute splendor of color, and costliness of material, for beauty of form, and elegance of design. The false taste of Venice grew out of immense and suddenly acquired wealth, seeking to ally itself to Art. The parallel thus suggested may teach us in America a useful lesson. Convinced as we are, that sound taste, based on and growing out of good models, is more wanted in our country, and needs more encouragement and developing, than mere constructive or mechanical talent, we shall take pains, without neglecting the last named departments, to seize every legitimate opportunity to enforce and illustrate, what, in our humble judgment, are sound principles and honest examples in the various Arts of Design. The masses in the United States have no knowledge of Art, for the plain reason that they have had no opportunity to instruct themselves in it. Here no noble memorials of the past chronicle the great deeds of an illustrious ancestry. No well-bestowed wealth has founded long galleries of sculpture, painting and antiquities, and opened their doors to the gratuitous access of all visitors. That obvious and imperative duty of all enlightened Governments, to provide such places for the use of their citizens, remains thus far unfulfilled, almost, we fear, unthought of by our General Government, and by the Administrations of the several States. The only historical memorials which we do possess, in our National Capitol, are so few, and, in general, so poorly disposed for inspection, that they form no exception to the general truth of our remark. Even the poor tribute of a Gallery and Museum commemorative of the various Aboriginal Tribes of North America, is withheld, and the treasures of ethnological research and pictorial skill gained by the adventurous exposure and individual expense of a CATLIN, are suffered to seek an asylum in a foreign land. Meanwhile the rapidly moving sunlight of a progressive civilization is passing over the western forests, and sweeping from the face of the globe the last traces of a noble and deeply injured race, whose chief crime was to possess a land which the Anglo-Saxon coveted.

One of the results which we hope may follow this Industrial Exhibition, is the growth in the popular mind in the United States, of a determination to establish museums of Antiquities and the Fine Arts, of Natural History, the Mechanical arts, and manufactures, in all our principal towns, and to sustain them out of the public purse, in the most liberal manner, free at all times to the access of all classes. We are sure, that as soon as the public mind is properly informed upon these subjects, that it will act with rigorous decision. A most important means of imparting such information, consists in the assembling together of objects of interest in all departments of human industry, skill and taste, and inviting all classes to come and inspect them. Such a movement is now, for the first time, made in the United States, and we sincerely trust that it will prove to be one productive of permanent results. So far as our humble endeavors can avail, we are determined it shall be so. As the choicest fruits and the loveliest flowers spring only where culture has elaborated, and toil prepared a genial bed, and sown the choicest seed; so can we hope for the truest and finest developments of human skill, only as the results of refined culture and the attentive study of the best models.

THE OIL PAINTINGS form a novel feature in the American Exhibition. These were excluded from the London building, chiefly, it is presumed, because of the difficulty of finding room for their display. The same objection might seem to apply with more force to the present case; but it must be remembered that we have comparatively few living Artists, and almost no Galleries, as sources of supply; while the number of works in this branch of Art, likely to cross the Atlantic, will be comparatively small.

We have from the artists of Dusseldorf, from sixty to seventy original easel pictures, mostly painted for the present occasion. From France there are seventy, and from Switzerland ten Artists exhibiting paintings. The cartoons of a few, which we have seen, are of high merit, and the names of the Artists are themselves a guarantee for their works. We intend to present one or more specimens of the style of each school in these pages—selecting those subjects, which, while they are of general interest, will, at the same time, admit of being rendered on wood with justice to the artist. The other modern schools of European Art are also to be well represented, if we may judge from the lists, and the American painters will not be wanting.

PRINCE ALBERT is a contributor of several oil paintings, while from Sardinia and Tuscany, works of Art in all departments form the chief part of the objects contributed to the New-York Exhibition. But as these objects, at this present writing, have not been taken from their cases, we shall advert to them more definitely upon another occasion.

The art of GLASS PAINTING has been much revived of late years, and numerous exhibitions of works of this description are on the lists of the Association. This beautiful art loses more than any other branch of pictorial representation, by absence of color, and we shall, therefore, be necessarily very restricted in our efforts to reproduce its designs. This, however, will be no reason why we shall not gladly take occasion to present its principles and practice in a proper essay. The public taste has become, of late, much directed toward the chromatic decoration of interiors, both in churches and in private houses. It is, however, the fashion for a certain class of writers to decry all attempts of modern Art to reproduce the stained glass of the Middle Ages. It is sometimes even asserted, that we no longer possess the secret of the rich colors, whose unfaded glories still dye the light-beams from the oriel of old churches of the time of the eleventh century. Such assertions can be founded only in ignorance of the resources of modern chemistry, whose list of metallic oxyds, capable of producing every tint of the spectrum, was never so complete nor so fully under the control of the operator, as at the present moment. If we have failed to equal the compositions of ALBRECHT DURER, it is because modern artists of equal talent have thought it not worth their while to engage in an occupation, which, by some strange perversion, has been considered as in some degree unworthy of the attention of men of genius.

We cannot expect to see the finest results of Art, in all departments, until artists abandon the silly notion, now quite too prevalent, that easel pictures in oil, and works in marble, are the only objects worthy of their attention, and that all other forms of Art are, in their nature, somewhat menial. BENVENUTO CELLINI was not ashamed of the craft of a goldsmith, although he dared to treat the Pope and his Cardinals with deserving contempt. RAPHAEL and MICHAEL ANGELO, and a hundred other glorious names, had no fear of being mistaken for plasterers, because they lay whole days upon their backs working up their immortal designs in fresco, upon the very mortar which their own artistic hands had spread. Nor did any of the great masters of ancient Art disdain to design a carpet, the fashion of a water jug, or to apply their talent in any direction in which it was wanted.

It will be a happy day for modern Art, when the genius of the artist, and the skill of the artisan, are again, as of yore, found in one person. Such a union would be most congenial with the practical spirit of the present time, which demands of every class useful results applicable to the wants of our present life. It is not easy to say why an artist is not as worthily employed in decorating a set of porcelain, with original designs, in producing his effects in colored glass, or in modelling the forms of beauty for whatever purpose, as when he is starving behind a canvas, on which, in his devotion to so-called high Art, he has reproduced the allegorical or mythological notions of a gone-by age and of a heathen religion.

GIFTS OF SCIENCE TO THE ARTS.

AN EXHIBITION which shows the present state of the World's Arts and Manufactures, furnishes also a convenient stand-point to review their history and the means and elements of their progress. In doing this, we have no expectation of adding to the knowledge of an *expert* in any art or science. Our humbler, and more widely useful task, will be to recall popular attention to the origin of capital inventions, especially those which are the gifts of science to the arts. Many of these are so interwoven with our daily life, that they have ceased to excite either our curiosity or admiration; and we find it difficult to conceive the world's condition before these familiar discoveries, creating new arts or new developments of old ones, changed the place and aspect of the world's industry.

It has become too much the custom, in quarters where a better spirit might be looked for, to ridicule the claims of science, and deny the obligations it has conferred upon industry; but it needs only a slight investigation to discover how groundless such denials are in reference to the past; and elsewhere in the RECORD we shall point out the necessity of a future liberal cultivation of pure science, with a view to its useful applications. In the present age, when invention succeeds invention with startling rapidity, no nation can neglect such sources of improve-

ment as, known or latent, exist in science, and hope to retain its manufacturing or commercial wealth and importance. On these, political influence is based with no remote dependence, and the instances are not unfrequent in which a new industry has changed, or materially modified, the international balance of power. An invention of this order of excellence, is the one with whose early history we commence this series of notices.

WHITNEY'S COTTON GIN.

The growth of cotton, its manufacture, aud the commerce to which it gives rise, constitute the most extraordinary industry recorded in the world's history. In Great Britain, the chief and wealthiest seat of its manufacture, its humble commencement dates from the beginning of the eighteenth century; its complete development has been the work of the last fifty years; and in 1851, it employed one-eighth of the population of the United Kingdom; its exports were valued at £30,000,000, and its taxes contributed one-fourth part of the whole national revenue.

The raw material which supplies this vast industry is obtained chiefly from the United States. Of the whole amount consumed iu England, this source furnishes 84 per cent.; about 10 per cent. comes from India, 4 per cent. from Brazil, and 2 per cent. from the Mediterranean. The cultivation of cotton has followed the course of empires. From India, where it has been used from time immemorial, it advanced through Arabia, and after lingering on the shores of the Levant and Northern Africa, it crossed the ocean and rested on our Atlantic coast. Here it has fouud its permanent and most extensive seat; it has occupied the whole of the Southeru States, and without deserting the old, still seeks new fields in the virgin West.

American cotton has two principal varieties; the *sea-island*, the finest and longest in the staple, is grown ouly on the sandy islands of Georgia and Carolina. It is easily cleaned by simple mechanical means; but the shorter staple of the *upland* variety is so firmly entangled with the seed, that its separation by hand labor involves an expense exceeding the value of the product. This, however, was the only available means previous to 1793. In that year the genius of ELI WHITNEY did for the planters of the South, what ARKWRIGHT, CROMPTON, and WATT had already done for the manufacturers of England. He invented a machine by which the seeds and impurities were separated from the cotton with the utmost facility, and thus gave to American planters the practical monopoly of cotton growing. There is nothing to be compared with the increase in its cultivation subsequent to WHITNEY'S invention, except the corresponding extension of its manufacture in England. The absolute dependence of the cotton trade upon this single cause is shown by the fact that the States which, in 1785, exported five bags, and in 1793 three hundred and seven bags, were able in 1794, the year when the Cotton Gin came into general use, to produce a crop of 17,777 bales, of which over 3000 bales were exported. In 1849, the export rose to 1,500,000 bales; which amount must be largely increased in 1852 and 1853, the whole crop in the United States being about 3,500,000 bales.

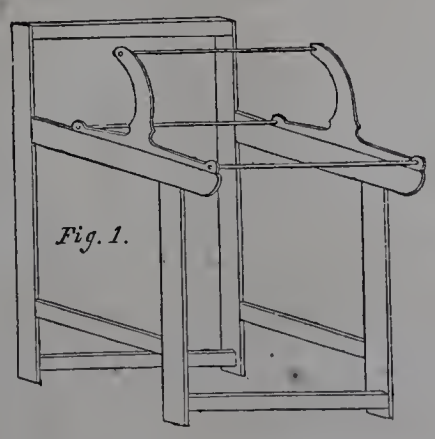


Fig. 1.

Illustrations of the original, as well as present construction of a machine, which has exercised so striking an influence upon the value of the staple that clothes the million, cannot fail to be acceptable to our readers. The Cotton Gin received several improvements from the inventor up to 1805. In the two years following, Mr. WHITNEY manufactured, at New Haven, seventy or eighty of his improved machines to fulfil a contract with the State of South Carolina. He was assisted by Mr. JOSEPH SMITH, who is still living in New Haven, and has recently testified in a court of law, that the Gin described below is one of those made at that time, and that it has all of WHITNEY'S improvements. This Gin is now in possession of Bates, Hyde & Co., manufacturers of the Eagle Cotton Gin, at Bridgewater, Mass., and from this the following drawings have been made.

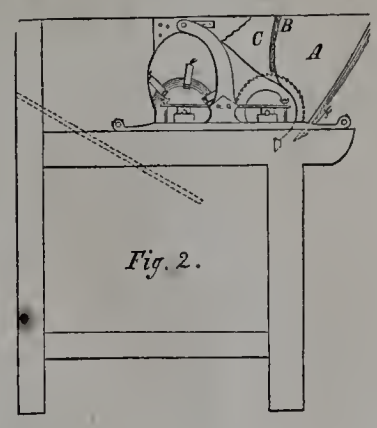


Fig. 2.

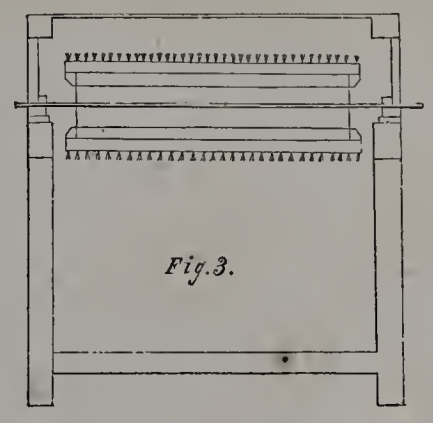


Fig. 3.

Fig. 1, represents the frame supporting an iron form, upon which the saw-cylinder and brush are hung. Fig. 2, gives an end view of the machine, which shows the mode of boxing the journals and retainiug them in place. The seed-board of the hopper A, is connected with the upper part by hinges, and may be placed at any required distance from the saw. The back of the hopper B descends nearly to the saws just behiud the grating. The rear branch of the gratiug makes the bottom of the moting-trough C; it also contains a

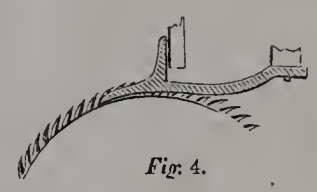


Fig. 4.

movable false bottom of tin, which catches the motes. The cylinder contains 40 saws, 6¾ inches in diameter, each having 106 teeth; they are separated at distances of ⅜ of an inch by block tin, or pewter castings. The 7-inch cylinder brush has 6 wings, each extending from one inch below to two inches above the surface, where they receive oblique tufts of bristles. In fig. 3, a longitudinal section of the brush is shown; its wings are seen to extend beyond the heads, and form what are called *projecting lags*. The machine has a large opening againat the ends of the brush to admit the air freely to these lags, and thus prevent the cotton from winding upon the axis of the brush. The mote-board, made of slats two or three inches wide, is indicated by the dotted lines in fig. 2. The hopper, moting-trough, &c., forming one part of the Gin, and the top and ceiling back of the openings, are each hung upon the upper bar of the iron form, and may be turned back at pleasure. In the first Gin rows of pointed wires were used, from which the transition to circular saws was natural. The cast-

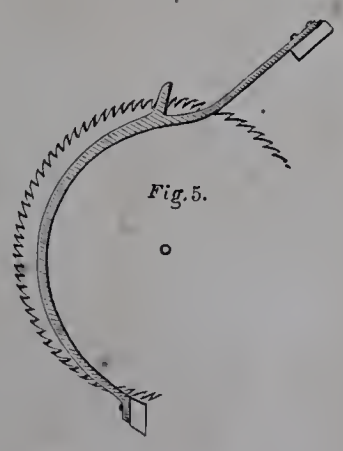


Fig. 5.

[From p. 9.]

juster appreciation of the true place and uses of Art. We are no longer contented with the plainness that was once satisfactory. A demand for decoration has arisen in every branch of manufactures; and although ornament has sometimes been used to excess, and inappropriately, it is still a movement in the right direction, and shows the necessity of an art-education among the people by familiarity with the works of the best masters. Within a few years this has become possible by the discovery of new methods and materials capable of reproducing works of high art, with beauty unimpaired, and at a price which makes them accessible to all. In ceramic manufactures, such improvements have been numerous and important. The introduction of Parian, a comparatively new material, has given to these manufactures a feeling of Art and a power of expressing it unknown in other materials. Sculpture is rendered by it more faithfully than pictures by engraving. The rich, transparent tone, and semi-opaque shadows of marble preserve all their softness in Parian. The introduction of Parian into general use for statuettes, vases, and other ornamental works, is due to the enterprise of Mr. Alderman Copeland, whose extensive manufactories at Stoke-upon-Trent, Staffordshire, produce every variety of pottery of unsurpassed excellence. We have enriched several pages of the Record with engravings of the more artistic of the specimens displayed in the Exhibition by the agent of Mr. Copeland, Charles C. Leigh, of New-York.

The first of the examples selected, commencing the ninth page, is a group of Pillars, Vases and Seats, for the garden and conservatory. Among them is the celebrated Warwick Vase, twenty-two inches high and thirty inches wide, surmounting the central column. The beauty and fitness of these objects must commend themselves to every one who can appreciate Art or excellence of workmanship. Immediately below, on the left, is the Garden Vase, twenty-six inches high, from the Townly Collection in the British Museum. On the right of the last is a Grecian Vase, five inches in height, with a top perforated to receive cut flowers. Next follows a Vintage Jug, produced in several sizes, with a troop of boys gathering the clusters from encircling vines. On the right, occupying the whole length of the page, is an original ornate Pilaster Panel, painted in encaustic or wax, in the Raffaelesque style of Arabesque. The medallion in the centre represents a personification of the United States awarding a crown to Industry. This beautiful decoration is the production of Eugenio Latilla, an eminent artist of this city. We continue the illustration of the works contributed by Mr. Copeland upon this page with an

engraving of the Poppy Candlestick, composed, as its

name implies, of the somniferous plant. The base is formed of expanded leaves, whose stems coil about the

handle, while the socket is made of an open, and the extinguisher of a closed capsule. Underneath it is a Vintage Pitcher, ornamented with a wreath of vines and grapes, and bearing on its side a design of the infant Bacchus holding the thyrsus, and borne in the arms of two boys. The Hanging Basket, executed in Terra Cotta, is intended for the parlor cultivation of Orchidaceous and other trailing plants—an elegant pastime which we should be glad to see introduced among our countrywomen. The cultivation of beautiful flowers is an employment most fit for beautiful women. That their fair hands should tend, and their watchful care assist in developing the floral emblems of their own purity, and grace, and loveliness, accords with all we like to know or think of the daughters of Eve. A cultivated taste for flowers ranks with *connaissance* in the Fine Arts, as indicating intelligence and refinement. 'Tis a pity that any one should wait for expensive greenhouses to gratify that taste. A few vases and hanging baskets are all that is requisite for the cultivation of the rarest and sweetest of the floral kingdom, and to realize as much pleasure as may be gained from the princely gardens at Chatsworth. The statuette, 9½ inches high, placed on the right, represents a Nereid, one of the lovely divinities to whom the beautiful mythology of ancient Greece assigned the Mediterranean as their abode, in distinction from the Naiads, who were nymphs of streams and fountains, and the Oceanides, who dwelt in the great ocean. The remainder of the page is occupied by an Etagere, profusely and elegantly carved in rosewood. This fine specimen of American

cabinet-work, is from the establishment of T. Brooks, Brooklyn, N. Y. The demand for richly

carved furniture in the renaissance style which began a few years ago, keeps pace with the in-

crease of wealth and the prevalence of ornamental architecture.

We again recur to the productions of Mr. Copeland. The Parian statuettes, placed on either side, are modelled after the designs of Cumberworth, and represent the inseparable Paul and Virginia, with the story of whose romantic love and friendship every child has been made familiar by the charming tale of Bernardin de St. Pierre. The Lily Flower Vase is composed of the leaves, and decorated with the delicate drooping bells of the lily of the valley, the loveliest of the flowers that bear that lovely

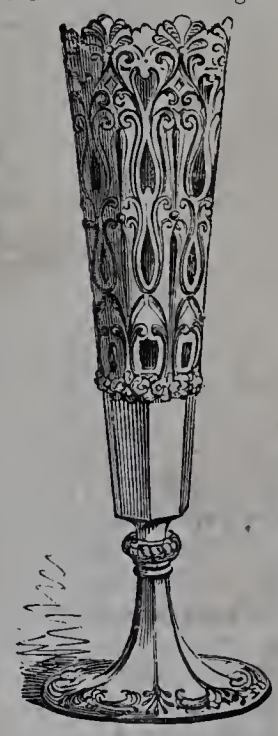
name. Upon the opposite side is a Gothic Vase, thirteen inches in height, whose sides are pierced to show its glass or enamelled lining.

The engraving which occupies the centre of the page, represents the bust of Proserpine, by Powers. The head is ideal, and we may receive it as embodying our great sculptor's conception of female beauty in repose. The wreath of leaves and flowers which encircle it, allude, perhaps, remotely to the legend, familiar in the poets, of the field

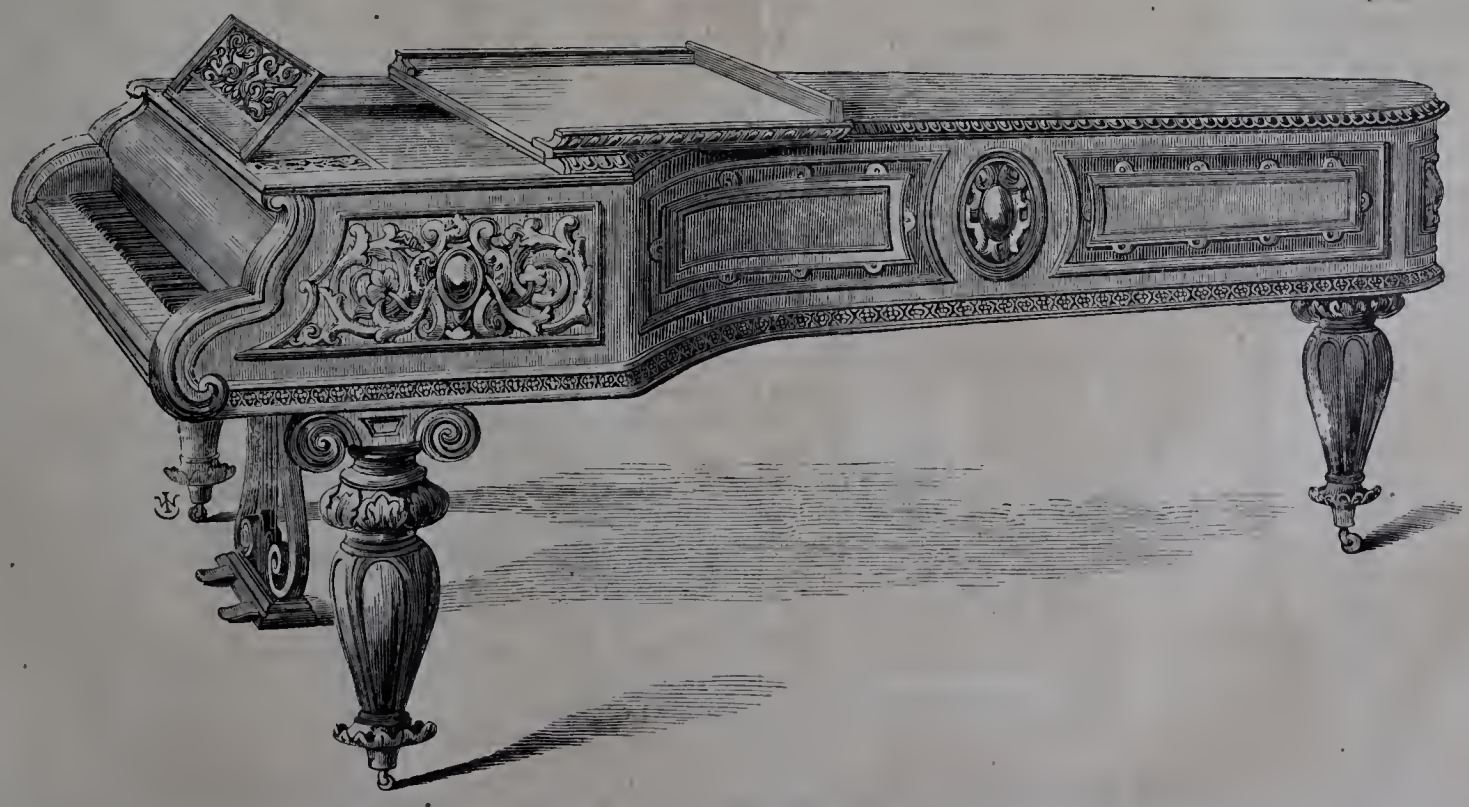
> Of Enna, where Proserpine gathering flowers,
> Herself a fairer flower, by gloomy Dis
> Was gathered.

The learned Germans who regard the whole Grecian mythology as personifying natural phenomena, interpret the legend as follows: Proserpine, who is carried off to the lower world, is the seed corn that for a time is buried in the ground; Proserpine, who returns to her

mother, is the corn which rises again to support



mankind. The Proserpine is exhibited by Sidney Brooks, Esq., of New-York.



The rosewood horizontal grand Pianoforte, engraved on this page, is from the well-known manufactory of William Stodart & Son, of Golden Square, London. The mechanism of Messrs. Stodart's pianos is remarkable for its simplicity, efficiency, and durability, and these sterling qualities are united with exterior beauty.

brass grating model is shown in fig. 4. The improved grate, fig. 5, must have been the fruit of skilful research. It will be seen that the forked grate is no recent novelty.

The Eagle Cotton Gin, of which an engraving is here given, although modified by improvements of various details and workmanship, still remains substantially the same as in the original invention.

It is a theory much in favor with inventors and the public, and often enforced by many plausible instances, that brilliant discoveries are made by accident; and, indeed, it is easy to collect examples where chance has apparently given birth to very wonderful realities. But if we could institute more careful inquiries, we should learn that the fortunate accident only set in motion a train of thought in a mind already prepared to receive it. Such accidents never happen to fools. A majority of cases show us the new discovery elaborated by repeated trials, and each improvement won at the cost of unremitting experiment and thought. Such was the case with WHITNEY.

In the year 1792, while residing in Georgia, he had often exhibited his peculiar talents, by various inventions to gratify the lady in whose house he was a guest. By her he was introduced to several planters as a fit person to give value to their cotton crops, by inventing an expeditious method of cleaning it. He saw how desirable the object was, and felt that he could accomplish it. Having provided himself with a quantity of cotton in the seed, which, until then, he had never seen, and, making his own tools, he shut himself up, until, after several months of seclusion, he emerged with the Cotton Gin to testify to the success of his prolonged exertions.

THE BRITISH COMMISSION.

TIMES are changed, surely, when Great Britain thinks it worth while to send a Commission of her Nobles and her distinguished Men of Science, to report upon the arts and industry of the United States. The World has certainly in these latter years advanced in catholic and liberal sentiments, and nowhere more signally than in Great Britain. We have formerly welcomed to our shores the Government Commissioners of France, of Prussia, and even of despotic Austria and Russia, to look into our systems of prison discipline, of popular education, and our various industrial arts. The Turk has so far yielded his Asiatic torpor to the impulse of progress, as to send to the western world for his cotton-growers, geologists and engineers, and has subsequently dispatched an agent to make a reconnaissance of the various States of his Republican friends. But Great Britain, confident of her own strength, has heretofore rested in careless disregard of the progress in arts of her transatlantic scions, and has amused herself with Jonathan's self-love and fondness for vaunting his own performances. If she has been sometimes startled in her dreams of political economy, by the alarming dependence of her manufacturing population upon a single great staple of American agriculture (an alarm not diminished by the unsuccessful experiments to force a supply of cotton from India), she has always consoled herself with the comfortable reflection that the United States were, and must continue to be, her best customers for the products of her looms and forges. This conservative and self-sustaining sentiment has been particularly strong in the minds of the agricultural population, who have been ready to sneer at the thought of competition from American skill in any department of industry.

The Great Exhibition was a noble step, worthy of England's place among civilized nations, but not a final one; it was a means to an end, and not the end itself. The Commission whose appointment it is our gratifying duty to record, shows one mode by which the Exhibition will be the world's permanent benefactor, by stimulating nations to mutually investigate their resources, and supply their mutual deficiencies. In England, it has shown manufacturers that they were weakest in many points where they thought themselves strongest. The reports of the Juries assure us of the superiority of nearly all the continental manufactures in the adaptation of the arts of design to the purposes of utility and ornament; and it was found, besides, that English iron and steel were returned from the United States in the form of agricultural implements, which were sold in London, all expenses paid, at little more than half the cost of such tools of her own manufacture. In spite of all the deeply-rooted prejudices of her agriculturists for the ponderous and misshapen implements of toil, which they had for generations been accustomed to use, the American tools have pushed their way into general favor. With such arguments as these, more conviction was carried in a day into the minds of Her Majesty's subjects, of the existence of a people in the western world, able to compete with them, than all our vainglorious boasting could have accomplished in a thousand years. And this too in spite of our acknowledged short comings, greater by far and more crushing to national pride than can be well understood by those who were so fortunate as not to see them. Indeed, there was for Americans, at the London Exhibition, more cause for mortification, that we had so sadly misrepresented ourselves, than for the indulgence of self-congratulations. Like England, we too learned on that occasion, that we were in some points strongest when we made no boast, and weakest where we laid our strength.

It is not possible accurately to estimate the results of the London Exhibition upon the future of the world's progress—one of those results we may safely say is seen in the present COMMISSION. The American Exhibition of New-York has served as the occasion for sending it at the present time. We are assured, however, that the powers of the Commission are not confined within the walls of the building on Reservoir Square, but that they are to investigate all that can be seen of American skill and progress in every department of industry. The delay in the opening of the building has been, therefore, of some advantage, as it has furnished the British Commissioners with an opportunity of seeing, meantime, many things in the neighboring States which they might have otherwise missed.

The Commission is composed as follows, viz.:—

The EARL OF ELLESMERE.
Sir CHARLES LYELL, F. R. S., F. G. S. &c., &c.
Mr. CHARLES WENTWORTH DILKE, London.
Mr. THOMAS WHITWORTH, of Manchester.
Mr. GEORGE WALLIS, of Birmingham,
Prof. JOHN WILSON, F. R. S. E., F. G. S., F. C. S.

The three first are ROYAL COMMISSIONERS, that is, they are members of a permanent Commission, emanating from the Queen, in 1851, for the London Exhibition, and continued as a permanent chartered Board, charged with the custody and direction of the surplus fund, accumulated on that occasion. Hence the propriety of naming these distinguished gentlemen upon the present GOVERNMENT COMMISSION to the United States. The three last named gentlemen are simply Commissioners appointed for this special duty, and whose office will cease when they have rendered their report.

The EARL OF ELLESMERE (formerly Lord Francis Egerton) is one of the wealthiest of the English Peers, and is distinguished for his devotion to literature and the fine arts. He came to America in the Frigate Leander, accompanied by his family. The Earl was born in 1800, and is the second son of the late Duke of Sutherland. As an author, the Earl is respected for his excellent rendering of the poems of Schiller and Körner, for his spirited version of Goethe's Faust, and for his Guide to the Study of Northern Antiquities, published by the Royal Society of Antiquaries of Copenhagen. His "Mediterranean Sketches," was the result of a pleasure jaunt in his own yacht in 1840, when he visited the shores of the Levant, to enjoy its classical and picturesque associations. His lordship has also figured in political life. As Lord Francis Leveson Gower, he was a member of Parliament in 1830. Under Lord Anglesey, he was Secretary for Ireland, and Secretary at War under Lord Wellington. His magnificent gallery of paintings, inherited from his grandfather the Duke of Bridgewater, and greatly enriched by his own purchases, is one of the few private galleries in England which is kept open at all times for the public. Among other valuable works of Art contributed by the Earl to the American Exhibition, is the original CHANDOS portrait of Shakspeare. This unique memorial of the great Dramatist is of itself attractive enough to draw throngs of visitors to the picture gallery. It is understood that the Earl of Ellesmere will devote himself particularly to the Fine Arts Department of the Exhibition.

Sir CHARLES LYELL is quite too well known in America to need any introduction at our hands. This is his fourth visit to the United States, where he can probably count nearly as many personal friends as in England, and as many readers for his truly classical works on Geology. His two series of published travels in the United States are models of fairness in their views of society in America, and permanently valuable for the great stock of geological observations they embody. It is certainly not very creditable to us in America, that the Geological Map of the United States, appended to the first series of his travels, and at the date of its compilation, a very creditable production, still remains the best, if not the only general map of the kind which we have.

Mr. DILKE was one of the three Executive Commissioners who had entire charge of the London Exhibition. His labors upon that occasion were constant, various, and most ably performed, and are the more honorably remembered, inasmuch as he has steadily declined receiving any consideration or reward either from his Government or from the Commissioners. He is known as a distinguished critic in literature and art, and has been long connected, as proprietor, with the London Athenæum, one of the ablest literary journals in our language.

Mr. WHITWORTH is what we in America understand by a practical man—he is England's great tool-maker, and is known wherever in the wide world Manchester tools are used. His micrometic dividing engine, for measuring the millionth part of an inch, excited the greatest attention among the mechanical wonders at Hyde Park. This apparatus is among the other curious and valuable machines which Mr. Whitworth shows in New-York.

His new method of obtaining perfectly plain surfaces in hard materials, was the subject of an able paper which was read by him some years since before the Mechanical Section of the British Association. Lately he has made important suggestions to the Government of Great Britain upon an improved method of fixing the length of the standard yard measure—suggestions which have received

the support of Sir John Herschel, and other distinguished physicists in England. He has also an important plan respecting a uniform guage for ships' screwbolts, which he is urging at present upon the attention of the English Admiralty, and also upon our authorities at Washington—the adoption of which will be a great blessing to all maritime nations.

The readers of the London Art Journal have not forgotten the admirable paper of Mr. Wallis on "Art, Science and Manufacture as a Unity," an essay in four chapters, which elicited from Mr. Hall, the distinguished editor of the Art Journal, a complimentary prize of one hundred guineas. Mr. Wallis is Head Master of the Government School of Design at Birmingham, to which situation he was advanced by his merits from the same post in the Manchester School of Design, which he had formerly held. It is to be hoped, that one result following our American Exhibition will be the establishment of similar schools of design for the benefit of our manufacturing districts, in which all who choose may have an opportunity to study the principles and practice of Art.

The Agricultural interest of Great Britain could not have been confided to a better representative than Prof. John Wilson. His long experience as a writer and teacher, fit him peculiarly for this department. Formerly Principal of the Royal Agricultural College at Cirencester, and Chairman of the Commission on Juries at the London Exhibition, he has enjoyed rare advantages for making himself thoroughly acquainted with all that relates to the great departments of Agriculture and the Raw Materials generally. He will give his special attention to our resources in produce, and in agricultural tools and implements.

A glance at the various Juries and Commissions in the "Report of the Juries" of the London Exhibition, will show that all the gentlemen upon the present Commission are men of large experience in their several departments, and quite familiar with the detail of management upon such occasions as the present. Much of the success of this Commission, in forming a correct estimate of the resources and relative position of the United States, will depend upon the treatment they meet, at the hands of the various parties to whom they must resort as the reliable sources of information, in the several departments to which their Commissions refer. We cannot for a moment question that they will find every where the greatest willingness to forward their views. We hope that they may be able to say that they have found no doors closed against their entrance, and no narrow-minded withholding of the various information sought. Such unwillingness, where it exists, is generally a proof of weakness; and it is certainly true that we have, in nearly every case, more to gain than we have to impart, especially in the various arts of applied science.

INTERIOR DECORATION.

INTERIOR decoration has been practised in different countries from the most remote periods, and it has assumed national and marked characteristics, as among the Egyptians, Assyrians, Hindoos, Chinese, Greeks, Romans, and Saracens. From the greater freedom of intercourse in later periods, the peculiarities of the art have been less decidedly pronounced, yet there has always been in each style sufficient to render it national and unique; as the Renaissance, the Raffaelesque, and the Arabesque. The latter, whose beauty and suitability to modern times, has caused it to be so widely diffused, commenced, and was invented by Ludius, a painter of the time of Augustus Cæsar. The exquisite frescoes of the Baths of Titus, buried for centuries in the devastations of the Roman wars, were resuscitated in the sixteenth century, and the sight of them revived the style of the Arabesque, which was brought out and perfected by the prince of painters, Raffael d'Urbino, since whose time it has received the name of the Raffaelesque style of decoration.

Greece and Italy have been foremost in all the arts of design, and the ornaments of their dwellings and public buildings have remained as examples and authorities of taste, down to our own age. The Greeks carried the arts into Italy, and the paintings at Pompeii and Herculaneum are the works of Greek artists. The Italian houses are still decorated, from the abode of the artisan to the palace of the noble: the former in tempera (distemper, or size-color erroneously called fresco in the United States), the latter in genuine fresco, which is painting on a wet stucco. The colors of genuine fresco become permanent and indelible; distemper, on the contrary, is easily obliterated, and has none of the high qualities of fresco. Germany, in the present day, is following Italy in interior decoration, and has produced some of the finest works of modern times under the patronage and direction of Louis I., ex-king of Bavaria.

In England, where wealth might be expected to minister to taste, the upholsterer, not the artist, is consulted by the nobility; there is therefore abundance of paper and gilding, but little art, or genuine taste, in the disposition of ornament in English mansions. New-York, in this respect, bids fair to surpass London, for already there are several buildings that show specimens of good taste and judgment in artistic decoration. It is true, they are not in fresco, though called so, but in distemper; yet when this fact is generally known, proprietors and societies will demand the real fresco done in the stucco, instead of that which has only its name, since the difference between the two is more than nominal. Much has been done here in chiaro-oscuro (brown and white), but these decorations seldom go beyond ornament, and may be executed chiefly by mechanical means, while fresco requires a combination of all the highest excellencies of art.

Interior decoration, as practised by the Egyptians in their temples and palaces, though abounding in fine examples from which to learn principles of grandeur, is not calculated for adoption, owing to the exclusively national character pervading it, circumscribed still more by peculiar religious laws. The best specimens of decorative painting among the Egyptians, are to be found on the coffins of their kings and nobles. These are in tempera, or size-color, afterwards varnished; burnished gold also forms parts of these elaborate decorations which resemble in some degree the highly wrought illuminations of the fifteenth century. The Egyptian mural decorations painted on stucco, and modelled or incised into form, were inverted representations like a seal engraving, and painted simply with local color; the flesh is reddish, without shadow or lights, chiaro-oscuro forming no part of Egyptian painting; red, green, yellow, and black were used for the draperies, and blue, sometimes studded with stars, for the ceiling; while the walls were covered with histories, legends, and ceremonies, painted on a white ground. Without perspective, anatomy, or light and shade, Egyptian painting possesses dignity and elevation. Its simplicity and severity of outline form the true elements of the sublime, and these high qualities characterized all their architecture, as well as decoration; vulgarity and commonplace were utterly excluded from both.

The interior decorations of Assyria and Babylon (with which the excavations of Botta and Layard have made us acquainted), were based on nearly the same principles as those of the Egyptians, except, that instead of being colored intaglios, they were bas-reliefs in alabaster, showing motion and action, while in the former all is passive. The eye, like that in Egyptian painting, is always full, even in a profile view of the face. Many of the historic subjects are on a blue ground, and must have had a charming effect when first painted; the gorgeous chariots, with prancing horses, and the winged deities of colossal proportions, possess a degree of grandeur that compensates for the absence of all lesser excellencies, and are well worthy of observation and study.

The Greeks, unlike the Egyptians and Assyrians, called into exercise all the agencies of art; though they gained rich stores of power from those nations, the Greeks were untrammelled and free to use every appliance that nature in her infinite variety presented. Egypt served as a firm basis to the Greek, while Assyrian art supplied him with materials for a superb superstructure, which he carried to a height that still makes men wonder and admire. The Greek temples and edifices, public and private, were decorated with infinite taste. Phidias sculptured their exteriors, Polygnotus and Micon painted interiors in encaustic, as is recorded of the Poecile, where, among many exciting subjects, the triumph of Theseus and the victory of Marathon, were executed by the public desire.

The Greeks were the inventors of encaustic and fresco painting for decoration, and these are the two most valuable and durable modes for that purpose, The Romans eagerly adopted Greek art, for they discerned its pre-eminent excellence. The cities of Pompeii and Herculaneum, originally Greek colonies, show Greek painting exercised under Roman influence and adapted to Roman customs. The encaustic and fresco paintings of Pompeii are models of mural decoration; and the best we possess in modern times, is but a distant imitation of them. The beauty of the polychromatic style is there seen, transcending all the false pretensions of gilt, papier-maché and mirrored walls; and when exhumed after a burial of seventeen centuries, it reappears to instruct the eye of this enlightened age, and to put to shame the gewgaws and tinsel that are miscalled taste. Ephemeral fashions, however good for trade, should be excluded from the arts, especially in mural decorations; for want of observing this rule, there are numerous palaces and churches, even in Italy, that exhibit all the defects and corruptions of the period of Louis XIV. and Louis XV., and these, now that the fashion is past, are seen in all their native deformity; those on the contrary that combine fine taste with excellent workmanship, please now, as at first, and are esteemed by all nations.

It is to be regretted that cultivated Americans who enjoy the luxury of art abroad, should be content with whitewashed walls at home. If any attempt is made to decorate mansions here, it is generally in distemper (brown and white) only, without figures, and this, though often costly, adds little to the value or interest of a house.

Encaustic is a method of painting with wax and color. The wax is dissolved in naphtha, or some essential oil, and with this the wall or canvas is well saturated, and the preparation driven in by the application of heat. The ancients, as we see in specimens from Pompeii, frequently used a coat of black, upon which they painted the subject with wax in a liquefied state mixed with gum-mastic, or any adhesive resin. After this a coat of wax varnish was given, and the whole submitted to a sufficient heat to amalgamate and incorporate the painting and varnish together. In this state it is without glare, but a polish may be afterwards given by mere friction, if desired. When properly done, it is very durable, exceeding even the durability of fresco, as may be seen by the works that still exist. Any, and every color, may be employed in encaustic, for wax possesses the quality of pre-

We introduce upon this page engravings of two SILVER JUGS, which we have selected from the contributions of Mr. JOSEPH ANGELL, of London, designer and manufacturer of silver ware.

The first is ornamented in relief with a vine bearing clusters of grapes, and we presume that it is intended for a claret jug; the special object of the other we have not ascertained. In articles which, like these, are designed to be useful not less than ornamental, greater regard should be had to the fitness of the vessel's shape and ornament to its intended purpose. A jug may have all the elegance within the power of art to bestow, but, at the same time, the fact should not be forgotten that a fluid is to be contained in it, and poured from it, and its shape should be moulded with reference to these essential uses. Its mouth must be capacious enough to admit the hand in cleansing its interior, and to permit its contents to be poured out without the necessity of inverting it like a bottle, and the handles should be placed so as to facilitate this operation. In articles of

utility, symmetry and elegance must not be considered apart from use, but in connection with it, since what is abstractly graceful may become less or not at all so, when it is obviously misapplied to foreign or incompatible purposes. A design which would be noble and beautiful on the frescoed walls, or sculptured frieze of a temple, becomes ludicrous and vulgar if perpetrated in paper-hangings or wrought in a carpet. These principles are general in their scope and application, and the not infrequent violation of them which we shall have occasion to comment upon in the RECORD, shows how necessary a wide-spread æsthetic culture is, before we can become a really civilized and polished people.

The GANYMEDE of Thorwaldsen, the original work of that great sculptor, is exhibited by EDWARD BECH, Esq., the Danish consul for New-York. In that beautiful mythology which, in every age, has furnished to the sculptor the finest subjects of his art, the son of Tros and Callirhoë is said to have surpassed all mortals in beauty, for which, by command of Jupiter, he was carried off to heaven, where he was endowed with immortal youth, and made cup-bearer of the gods in place of Hebe. The sculptor, following the customary example of ancient art, represents a beautiful youth, with a Phrygian cap, kneeling, and giving food to the eagle from a patera.

The ornamental FIRE GRATE here engraved, is exhibited by GEORGE WALKER, of New-York. The body, and the scroll-work with which it is profusely decorated, are excellent examples of fine castings in iron. The arched mouldings surrounding the fire, and the horizontal moulding above, are covered with a brilliant varnish or enamel, and the space between them has landscape vignettes painted in colors and covered with plate-glass.

We fill another page with the beautiful statuettes and vases in Parian, exhibited by Mr. Copeland. The first in

order is Undine, the water nymph of German romance, modelled after Pradier. The VINTAGE VASE, underneath,

is ornamented with appropriate symbols—cluster-bearing vines which twine around the edge. That which follows,

called the GEORGIAN VASE, is eleven inches high, and is designed for the conservatory. A HANGING BASKET in terra-cotta commences the second column, and is follow-

ed by an antique VASE with a design from the

Elgin marbles. The statuette, modelled after the

original by Wyatt, in the gallery of the Duke of Sutherland, represents APOLLO when he was the shepherd boy of

Admetus. The finest of all these productions is the poetical SABRINA, modelled after Marshall, who represents her listening to the invocation of the brothers in Milton's Masque of Comus.

Sabrina fair,
  Listen where thou art sitting
Under the glassy, cool, translucent wave,
  In twisted braids of lilies knitting
The loose train of thy amber-dropping hair.

The page concludes with a statuette of Psyche.

serving even the most evanescent. Encaustic painting shows great softness and delicacy, and does not, like an oil picture, become darker by time. It also reflects, instead of absorbing light, and on this account it is well seen by artificial light.

Fresco painting is altogether a different process from that of encaustic. It is also, as remarked in the commencement of this article, far removed from what is called fresco in the United States, where this branch of art is almost entirely unknown. Fresco, as its name implies, is painted *while the mortar is wet.* A piece of stucco, composed of lime and sand, or lime and marble dust, is laid smoothly on the wall, when the artist marks out his design, or as much of it as he can complete during the day, for real fresco does not admit of retouching when dry. But few colors are admissible in this process, as the causticity of the lime destroys all vegetable ones; the earths are used, and some few oxides and minerals; the French Guimet blue (the artificial ultramarine) is very valuable, as it affords a substitute equal in appearance to the ultramarine, which formerly could only be obtained from the costly lapis-lazuli.

Fresco is acknowledged to be the finest variety of decorative painting. Michael Angelo said, that, compared with it, oil was fit only for women and children; and Vasari calls it, "veramente il più virile, più sicuro, più risoluto, e durabile, di tutte gli altri modi." Great knowledge and skill are required in each department of fresco, for no defects can be supplied, no mistakes remedied; the higher qualities of art, as composition, accurate drawing, and harmonious arrangement of color, are the points to be aimed at; grandeur and simplicity take the place of prettiness and detail, all must be masterly and decided; hence fresco is fitted to make great artists, and great designers, and we find that wherever it has taken deep root in a country, the arts have held a high position, as in Italy, and in our own day in Germany, where the great frescoes of Cornelius, Overbeck, Kaulbach, Lessing, Hess, and Schnor, have rendered Munich illustrious, and the resort of all who study or esteem the fine arts.

The United States, at a distance from the great examples of European art, should endeavor to form a high standard of taste, both as a means of elegant cultivation, and in order to advance their manufactures, for it is impossible for these to flourish where the arts of design are uncultivated. Take away taste and art from France, and what would become of her commerce?

Every branch of design, but more especially mural decoration, has a decided influence upon the manufactures of a country. It is natural to admire and study what is before and around us, and good taste, as well as sound judgment, is thus unconsciously promoted.

THE NEW CRYSTAL PALACE.

IT has always been a subject of deep regret with all who saw the London Crystal Palace that it should have vanished like a beautiful dream, almost before their eyes. It is known to all that the fairy-like structure of Hyde Park has been removed, that the ground which it covered is again a verdant sward, and that no trace remains to remind the inhabitants of Rotten Row that the most wonderful structure of modern times once stood upon their inclosure. It may not, however, be so generally known—and certainly not in the United States—that the removal of the Crystal Palace from Hyde Park has been only the prelude to its erection in a new and more beautiful form in the immediate vicinity of London. Many persons have affected to sneer at the Exhibition of 1851 as an ephemeral show, which made no more impression on the world's industry, than the passing shadow upon the landscape. We do not envy such people either their logic or their perceptions, nor do we propose to waste words upon them. It is sufficient to say that they forget, that as shadows cannot nowadays expect to escape if they fall upon the sensitive surface of a photographic paper or of a daguerreian plate, so the public mind by its peculiar preparation for the scene in question, received from the brief exhibition of 1851, an enduring impression, a daguerreotyping of new ideas—the leaven of whose vitality will continue to work long after the heads that planned and the hands that realized them, have ceased to be.

One of the great lessons taught on that occasion, was the capacity of the masses to appreciate and enjoy the pleasures which flow from refined culture in whatever direction. This lesson was so palpably plain, that a company of enterprising and most intelligent gentlemen was formed in London, who purchased the Hyde Park building of the Commissioners, with a view to erecting it in a new and more favorable situation. This they have accomplished by securing a tract of ground, of over three hundred acres, in an inclosure known formerly as Penge Park, near Sydenham, in the county of Kent, about six miles from London. This company possesses a paid up capital of nearly four millions of dollars (£800,000), and the real estate on which the building is now re-erected, cost more money than the whole structure as it stood in London. Although the establishment is as yet only in embryo, it already gives promise of a new species of enjoyment, refined and elevating in its character. There on the brow and summit of a hill, which commands a panoramic view of surprising extent and loveliness, the New Crystal Palace is rising in loftier and more beautiful proportions than before. With its magnificent surroundings, and the treasures of Art and Nature contained within its transparent walls, it will be worthy to represent to present and to coming time, the wealth of that nation, and that vast and imperial sway, which Daniel Webster once thought a corresponding magnificence of language fitting to describe. The arch of the central transept is now two hundred and ten feet from the ground, and a transept of proportionate dimensions is erected at each end. By these changes the interior capacity of the building has been materially increased, although the length has been diminished in consequence of them from 1,848 to about 1,500 feet. In place of the flat, ridge-and-furrow roof, which covered and disfigured the nave in the original building, a curved roof of glass has been substituted—whose light and graceful arches blend harmoniously with the aerial effect of the great transepts.

Sir Joseph Paxton is fully empowered to convert the surrounding grounds into an Eden of rural delights. The form and situation of the property are admirably suited to the highest triumphs of landscape gardening. The sloping hill-side attains an altitude so commanding, that a panoramic view is obtained on all sides. The parks and fresh fields of the luxurious vale of Kent in the foreground, and London and the misty hills beyond, open like a map beneath the spectator. Here the weary artisan, the pleasure-seeking, or the toil-worn citizen may share in all the newness and joy of the country, within sight of the mighty capitol,—the great throbbing heart of Christendom,—whose cloud of murky smoke which everlastingly hangs over it, speaks of wealth and power derived from a thousand work-shops of industry. For eighteen pence (about 35 cents), visitors are taken up and back to London, the visit to the Crystal Palace and its grounds being included. That is to say, a ride of twelve miles, and an enjoyment *ad libitum* in all the pleasures of the place, may be had for a little less than the sum elsewhere paid in England, for twelve miles of railway travelling alone.

The gentlemen who have formed this gigantic scheme to gratify and instruct the public, have done well to remember that its success depends upon its being perfectly accomplished, and that a restriction of expenditure which should mar any of its attractive features, would make the whole a magnificent failure in place of a triumphant success. Thus a million of dollars are devoted to the hydraulic arrangements alone. Water is pumped by very powerful steam engines to supply fountains and jets d'eau of every variety and of surprising height, while cascades and lakes and streams are all created by the same illimitable power. Statues, temples of roses, and architectural decorations lend their power to embellish the rural attractions. The arrangement of the plants and trees, and floral decorations of the grounds, is made with reference to their geographical distribution and character, as well as their beauty and picturesque effect. The principle everywhere prevails of uniting pleasure with instruction.

Within the building there will be an epitome of the great world without. The visitor in wandering down the nave, will pass in succession the characteristic vegetation of every zone, represented by the choicest and most perfect specimens of its living plants and trees; for under the lofty vaults of this new structure, the most ambitious palm-trees may rear their tufted heads. The immense collection of exotics formed during the last fifty years by the Messrs. Loddiges, near London, has been purchased for the sum of twenty-five thousand pounds, to adorn the establishment at Sydenham. These are disposed in the main entrance, hall, and porticoes, and are interspersed with statues and fountains, and at intervals, with aviaries of birds remarkable for their brilliant plumage or exquisite song.

As the great original works of art can be seen only by a long and careful study of numerous museums scattered over the whole of Europe, and the wonders of ancient architecture only by still more laborious and costly explorations of countries now not always civilized or easily accessible; it is plain that such pleasures must be restricted to the few, who may possess the wealth and leisure required for such undertakings. It has therefore been the design to group together at Sydenham models—copies of exact size and color—of all the most noted statues and groups which have come down to us from ancient Greece and Rome. For this purpose alone some sixty thousand pounds sterling have been applied,—and many unique pieces of sculpture have been thus reproduced for the first time. As, for example, the renowned equestrian statue of Marcus Aurelius, at Rome, upon the Capitoline Hill, which was never suffered to be modelled before. Numerous similar objects have been procured from the Museo Borbonico at Naples, and from other museums.

The arrangements to exhibit ancient and foreign architecture, decorative arts and manners, both public and domestic, are upon a scale of corresponding completeness. Across the grand entrance transept, four large and distinct courts are provided,—"one devoted to the exhibition of the Italian and revived classical styles of art in various branches; another to the Elizabethan, French, and Flemish renaissance; a third to the Mediæval style, from its cloisters and tombs to its ivories and enamels; and a fourth to the Byzantine, Romanesque and Norman works of Decorative Art. On the opposite side the visitor will wander through an Egyptian Hall, with its multiplicity of columns all richly painted with deities and hieroglyphics, and pass into side courts constructed under the direction of Mr. Layard, after the fashion of the palaces of Nineveh and Persepolis. From thence he finds his way into the less gorgeous, but more exquisite halls of Greece, where vases of the finest contour, statues of faultless proportions, and models of the most

beautiful public monuments of this most polished nation of the ancient world will court his study. Thence the Roman Court is reached, filled with specimens of the arts of those old masters of the world; less pure than Greece in their tastes, but perhaps more real." A Roman house, copied in all its details from Pompeii, and of actual size, about two hundred feet front, will convey a vivid impression of the interior life of a wealthy Roman, at the commencement of the Christian era. Adjoining this, Owen Jones has reconstructed the famous Hall of Lions of the Alhambra. Here, then, for the first time will it be possible to contrast, by actual examples of each, the characteristic styles of all ages and countries.

The various raw materials, gathered from the surface, or torn from the bosom of our planet, the products of primeval creation, or of annual growth, are arranged under the supervision of Prof. John Wilson, (one of the British commissioners to the American Exhibition.) The elements of civilisation will be displayed in such a manner as to show the various stages, and as far as practicable, the various processes of their manufacture under chemical or mechanical treatment, by which science combines them to minister to the comfort of life and the grandeur of nations. Models of mines, and of mining machinery—maps, plans, and sections of works, will be fully supplied.

In Geology, under the direction of Prof. Ansted, the structure of the earth, and of its various tribes of extinct animals and plants, will be represented in a style and with a completeness never before attempted. For instance, the monsters which inhabited our planet at epochs infinitely remote, and whose forms it is the glory of the distinguished palæontologists, Cuvier, and Mantell, and Owen, to have built up by induction from fragmentary, and often a solitary relic of them,—these tyrants of the Age of Reptiles, will be exhibited in lifelike and colossal reality. In the lake there will be two islands, of which one will represent the tertiary, and the other the secondary epoch, and each reptile will stretch or coil his huge length on the rock, wealden, or chalk, or lias, which was characteristic of the time of his existence. Here the astounded student will see Ichthyosauri and Plesiosauri, and all other saurians of whatever imaginable name, or shape, or size, as they looked while they were still gambolling in the flesh, in the morning of that antique world, from whose ruins we dig their bones. They are not the only inhabitants of these novel islands. Beneath the appropriate vegetation, mostly coniferous trees, may be seen the Labyrinthodon, a frog twelve feet long; the Megatherium, a huge sloth fifteen feet high; Dr. Mantell's gigantic Iguanodon; and lastly, that monument of Prof. Owen's anatomical skill, the Dinornis, a bird twenty feet high, or thereabouts, a sort of antediluvian ostrich.

The department of Zoology is under the direction of Dr. Edward Forbes, and Messrs. Gould and Waterhouse. It is not their intention to repeat the ridiculous caricatures of the animal kingdom so common in ordinary museums. Both the living and the stuffed examples in their charge will be distributed geographically, and surrounded with the plants and other accompaniments peculiar to their native haunts, whether in caves, or in jungles, or forests. In pursuance of this admirable scheme, aquatic vivaria, huge tanks of fresh and sea water are provided, in which fish that once "through groves of coral strayed," or in osier-fringed streams, will again, under the delighted eye of the spectator,

"Show to the sun their wav'd coats dropt with gold."

And with them, mollusks and crustaceans, polypi and corallines, and all the offspring of the sea, will display to the public gaze their infinite variety of curious forms and brilliant colors, hitherto unseen in their living beauty, save by the patient naturalist in remote islands and on solitary shores.

Dr. Latham, well known in the United States for his thorough scholarship and excellent philological writings, is the director of the department of Ethnology. Like Prichard, he prefers to make moral and mental peculiarities the basis of his study and division of mankind. Whatever we may think of this, it is impossible not to admire the energy with which he addresses himself to the task of forming a museum. Whatever can illustrate the different types and varieties of mankind, whatever can throw light upon their moral, mental, or physical characteristics, is a *bonne bouche* to Dr. Latham. Trinkets, weapons, and utensils, specimens of clothing, of language and traditions, specimens of hair, skulls, and plaster-casts, are gathered and arranged with vivacious zeal. Foreigners, of either sex, coming to London from beyond the sea, are coaxed or bribed, to submit themselves *au naturel* to Dr. Latham, who forthwith models them at full length in plaster.

The upper galleries will be entirely devoted to the exhibition of the Industrial Arts. These, overlooking the transept, will be apportioned to works in the precious metals, china, porcelain, and glass. Cloths, furs, leather, &c—will find their places in the northern galleries; substances, used as food, in those opposite. Philosophical and musical instruments, and all miscellaneous manufactured articles, have also their localities.

We have dwelt somewhat particularly on this subject, drawing our information from the Art Journal, and from private sources, partly for the sake of answering in some sense the inquiries of those who are more fond of asking, what good comes of such exhibitions—than of appreciating what is so plain to others—and partly for the suggestions which so naturally flow from it as to the future of our own enterprise. Speaking of this new phase of the London building, Mr. Hall says—"It was fitting that so vast and interminable a city should have its palace for the people, great as itself, and like itself, an epitome of the world; that its structure should be novel, and not hackneyed; that its contents should rank higher than the amusing, and should reach such a pitch of excellence, that instruction and knowledge of the most refined kind should be conveyed through the medium of the eye to all visitors; in a word, that the eye of the sight-seer should never weary of looking, while the mind should almost unconsciously imbibe knowledge, and that of a kind fully equal to the standard of modern excellence. Here many

"long in populous city pent,"

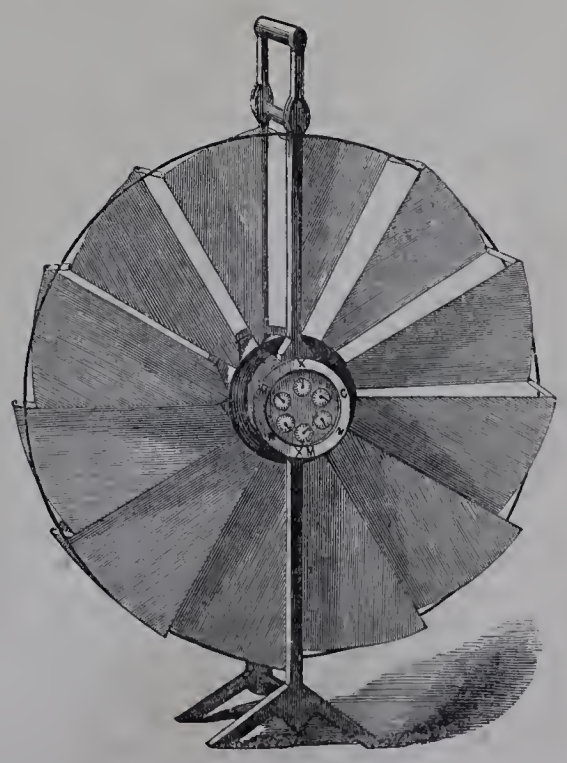
will recreate themselves in body and mind as effectually as a nobleman used to do by any European tour. Nay more; for here will the wonders of the Old and the New Worlds unite to show twice their beauties. Nature woos him in the gardens, and Art within the walls of this Temple of Fame."

We seem to see, in the plan of the new Crystal Palace, and in the grand ideas embodied in its arrangement, the germ of something likely to bud and bear fruit in the United States. We would add, before closing, that the funds accumulated as the net profits of the Exhibition of 1851, which amount to £170,000, are about to be invested in the establishment of an Industrial College, for the benefit of all who may choose to become its pupils. We soon expect to receive a copy of the report upon this subject, prepared by Dr. Lyon Playfair, who has visited, in its preparation, all the establishments of a like character on the continent. Dr. Playfair's appointment by the Crown to the office of Royal Commissioner for science is one of the fruits of the Exhibition of 1851. This is the first official recognition of the claims of science on the part of the Government of England—the incumbent of this office taking rank with the other high officers of State. When the report alluded to reaches us, we shall take care to lay its main features before the readers of the Record.

BIRAM'S ANEMOMETER.

THE instrument figured below, is designed for the purpose of registering the current of air in mines. The importance of having some ready method of measuring and registering the quantity of air circulating through the galleries and shafts of coal mines, is fully admitted by coal-viewers. In the recent report of the committee appointed by the British House of Commons, for inquiring into the causes of accidents in coal mines—the adoption of some mode of measurement and registry, is strongly recommended. In the United States, the same degree of necessity for such precautions has not yet been reached, partly because our mines of bituminous coals are as yet comparatively shallow, and more because anthracitic coals (which are more extensively wrought in Pennsylvania than the bituminous) yield comparatively little of the combustible gases so abundantly exhaled from the bituminous coals. In order to displace by fresh air these poisonous gases, as also the smoke of gunpowder, of lamps, and the products of respiration, it is requisite to build a fire in one of the shafts of the mine, and to keep it up at all times; the air passages of the mine being so arranged with doors and openings, that the draught of the furnace shall cause a movement of the stagnant air in the galleries.

Biram's Anemometer is designed to register these movements of the air, which it does by a combination of wheels with indices, similar to a gas meter. It is only twelve inches in diameter, and weighs about $2\frac{1}{2}$ lbs. Any slackening of the furnace or inattention in the furnace man, will be at once detected by the registry of this simple apparatus. The observer has only to record the position of the several indices at the first observation, and deduct the amount from their position at the second observation, to ascertain the velocity of the air which has passed during the interval; this multiplied into the area in feet of the passage where the instrument is placed, will show the number of cubic feet which have passed during the same period.



Within a few years articles in terra-cotta have come into extensive use for architectural and other ornaments, and this branch of art-manufacture has been carried to

great excellence and beauty. The materials used are the finest clays, free from oxyd of iron, which are mixed with calcined flints and crushed pottery, and baked at a

temperature but little below fusion. Modern terra-cottas are quite different from the articles known amoug the ancients under that name, and are much more dura-

ble. The beautiful examples engraved upon this page are exhibited by Henry Doulton & Co., of Lambeth. They consist of an ivy-wreathed Vase, a Vine Basket, a Water Cooler, with decorations in the mediæval style, and a group of Grecian and Gothic vases for a terrace or conservatory. The models are graceful,

teries are one of the most interesting localities in England. From thence come the fine porcelain services, which at the tables of the noble and wealthy are admired as triumphs of artistic and manufacturing skill, and the coarser varieties of earthenware for everyday use, which are produced by hundreds of thousands, and may be found in every cottage the world over. The group at the top of the page is an elegant porcelain Tea

Service, exhibited by Messrs. Ridgway & Co., one of the largest of the Staffordshire manufacturers.

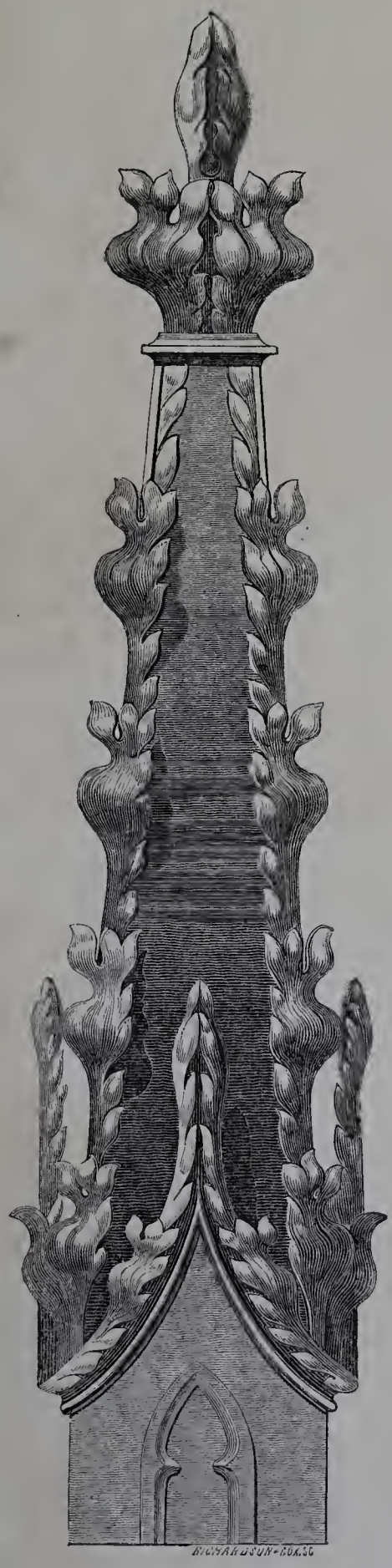
and the ornaments are applied with excellent taste and effect.

In an industrial point of view, the Staffordshire pot

We engrave upon this page two STAINED GLASS WIN-

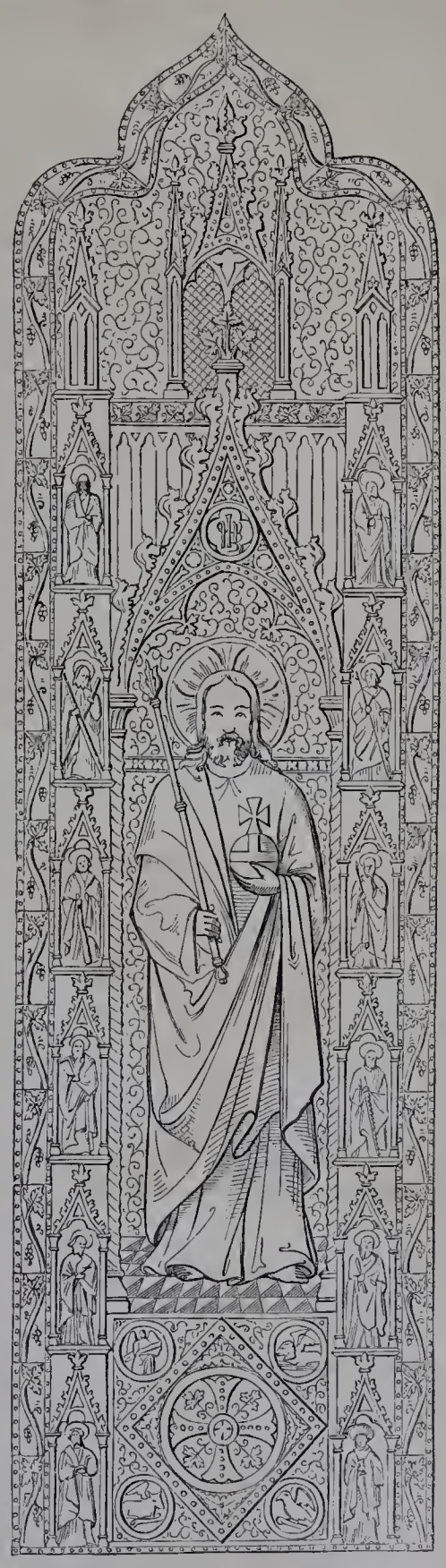
DOWS, which are creditable specimens of this beautiful art.

They are contributed by Mr. HOLLAND, of St. Johns Warwick. The one on the left is eight feet and nine inches in height, by two fect and two inches wide. It represents St. John holding in one hand the emblematic cup, and standing beneath a perpendicular canopy. The other is on a somewhat larger scale, being ten feet in height, and three feet two inches wide. The design of this presents Christ, holding the symbols of universal em



pire, and surrounded with the twelve Apostles, whose figures are placed in the shafts of the canopy.

The TERRA COTTAS on this page are contributed by Messrs. TOLMAN, HATHAWAY & STONE, of Worcester, Mass. They consist of a Corinthian CAPITAL and MODILLION, and a Gothic PINNACLE. The manufacture of Terra Cotta is yet in its infancy in this country, and the examples, though creditable to the enterprise of those who have commenced this business, cannot be compared with



the artistic works in this material found in other quar-

ters of the Exhibition, especially the Italian.

We have elsewhere alluded to the extent and importance of the Staffordshire potteries, among whose productions, those of Messrs. J. Ridgway & Co., have a high rank for their beauty and general excellence. From the numerous contributions of this firm, we engrave upon this page a Porcelain Fountain, whose elegance will at once commend it to the reader. The ground color is an orange red, bearing white rosettes, while the remaining decorations are gilt. Its height is about four feet.

The Shakespeare Cup, executed in gold, is the production of Mr. Thomas Sharp, London, by whom the same design in silver was exhibited in the Palace of Hyde Park. The cover of this beautiful work is surmounted by a figure of the immortal poet, and scenes from his plays decorate the sides. The subjects are from Lear,

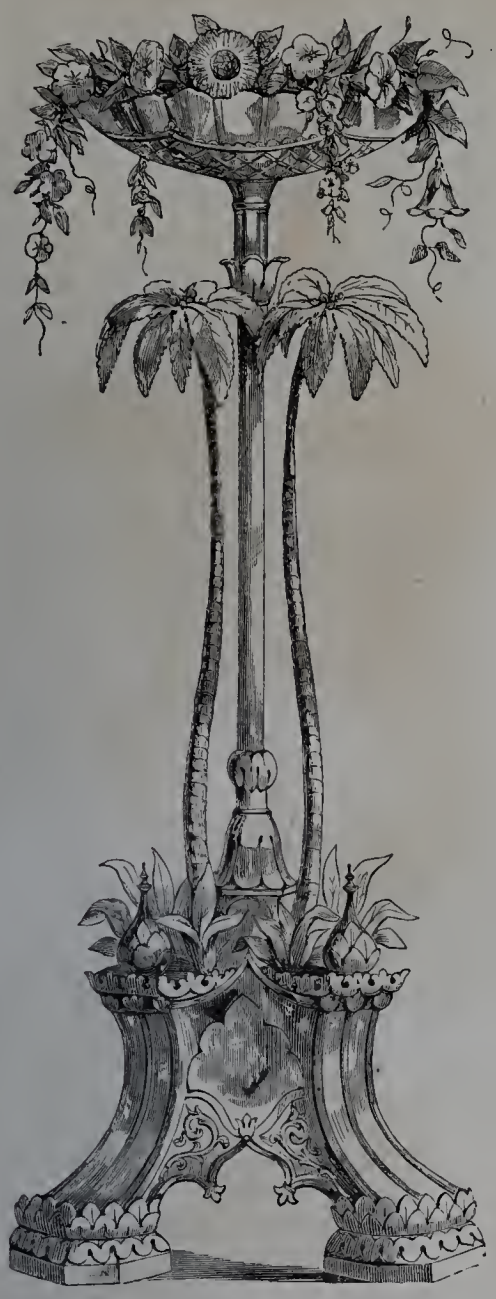
Julius Cæsar, The Tempest, Othello, Hamlet, and Macbeth. In the divisions on the foot are emblems which refer to the groups above.

The group, representing part of a Porcelain Service, is exhibited by Messrs. Sampson, Bridgwood & Sons. The articles of this service, both in their contour and the simplicity of their decoration, are examples of good taste and refinement.

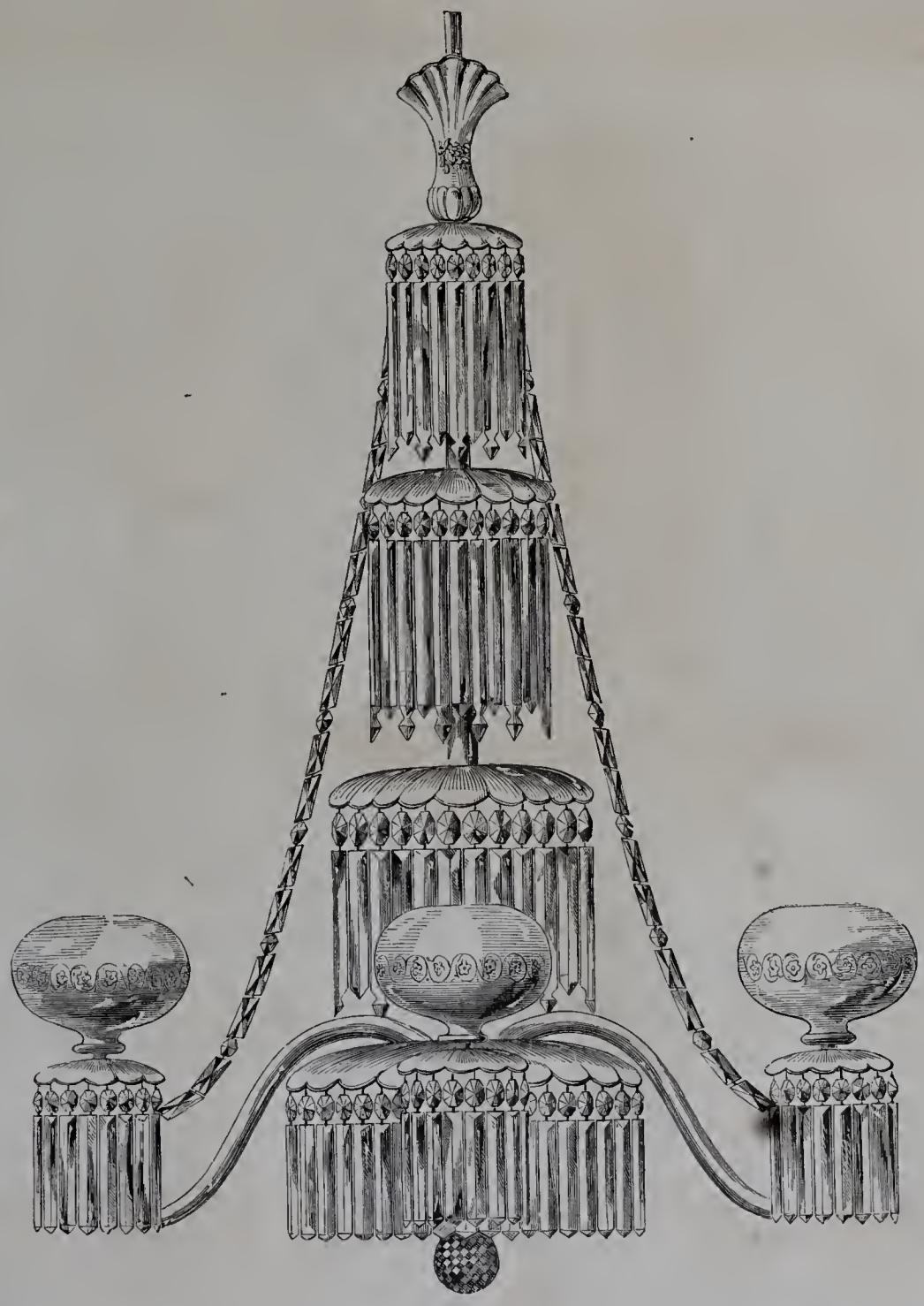
An exquisite specimen of the goldsmith's art is seen

in a Casket, exhibited by Mr. Joseph Angell, of London. It is executed in raised silver, with the medallions gilt. The design represents Anthony and Cleopatra, and in harmony with such a subject, figures are added emblematic of love and war. The casket is seven inches by five, and seven high.

The silver CENTRE DISH here engraved, is exhibited by Mr. JOSEPH ANGELL, Strand, London, manufacturer and designer of silver ware. It is executed in solid silver and heavily gilt. The companion piece will be found on another page.



The CHANDELIER, profusely furnished with prismatic glass pendants, is contributed by Mr. J. T. HALL, England.



In bookbinding, the true purpose of the art—to protect the volume within it—is so often overlooked, or rather, so systematically neglected and set at defiance, that we are glad to illustrate a contrary instance which has our entire approval. This notable exception to the general rule is exhibited by MATHEWS & RIDER, of New-York. It will attract attention and praise, but whether so much as it deserves is doubtful. For there is no glare or tinsel about it, no uncomfortably red sheepskin morocco, with gaudy bronze gilding, the baser metal outfacing genuine gold; no deceptive stamped-work, whose endless repetitions of even a pretty pattern become wearisome, and can never hope to rival the exquisite finish of an accomplished workman. It has none of these popular passports to favor, but is a solid, substantial, and honest piece of work throughout, executed at an expense of time and labor, which the most of our readers would think fabulous, and therefore we shall say nothing about it. The design is beautiful, appropriate and rich—as it is befitting that the cover of Owen Jones's Illustrations of the Alhambra should be—and withal as modest as rich. This example will show that the *art* of bookbinding is not unknown, though, we confess, not often practised among us.

THORWALDSEN'S CHRIST AND HIS APOSTLES is the subject to which we consecrate this page. This group is exhibited by its proprietor, EDWARD BECH, Esq., Danish Consul for New-York, and has been arranged under the special superintendence of Messrs. CARSTENSEN & GILDERMEISTER, the Architects of the Crystal Palace, and J. T. ELNNEWEKR, artist of Thorwaldsen's Museum, Copenhagen. The statues now exhibited are Thorwaldsen's originals, once standing in the Metropolitan Church in Copenhagen, where they were replaced by marble. In the Metropolitan Church they are so placed that the figure of Christ stands about fifty feet distant from the Apostles, and elevated three or four feet above the altar. This arrangement was impossible in the contracted space assigned to the group in the American Exhibition, and hence the Christ appears unduly gigantic, when brought into the same circle with the statues of the Apostles. The grouping in our engraving differs from the actual arrangement, and has been devised by the designer to bring all the figures of this august assembly within the limits of the page, while the size of the Christ has been purposely reduced to conform to the original intention of the artist. It is impossible by any engraving, unless it be on a very large scale, to convey any proper notion of the impression made by this wonderful group upon the spectator. Christian art has reached, in this immortal work of Thorwaldsen, its noblest expression. It is undoubtedly the great artistic feature of the Exhibition, a subject of universal and eternal interest, touching the springs of deepest feeling in the human heart. Ancient Art, while it has left us nothing nobler in execution, never handled so sublime a theme. We proceed to enumerate the figures as they stand in the exhibition, as the characteristic marks of each will enable the reader at once to recognize the corresponding figure in our engraving.

CHRIST, the arisen Saviour, appears in the midst of his assembled Apostles, greeting them with the words, "Peace be unto you." The expression of the whole figure is exactly such as meets the most lofty conception of his appearance before his "terrified and affrighted" disciples, when he said unto them, "Why are ye troubled, and why do thoughts arise in your hearts?" In the beautiful countenance the artist has reproduced in their best form those features which Christian art has handed down from generation to generation as peculiar to Christ. The hair is parted on the middle of the head, and flows curling in rich abundance over his shoulders. The breast, the partly elevated hands, and the feet show the scars of the lance, and the laceration of the nails, convincing even the incredulous Thomas that it was, indeed, his Lord.

PAUL, the Apostle of the Gentiles (1st statue on the right of Christ), holds a sword as the symbol of his martyrdom, while, with his right hand raised to heaven, he appears to exhort his companions to new faith in their Master's service. His countenance bears the expression of that deep thought which distinguished him as the most learned among the "glorious company of the Apostles." This Apostle is substituted for Judas.

PETER, the first statue on the left of Christ, holds in his hand the keys of power.

SIMON ZELOTES (2d statue on the right), holds in his right hand the saw, in testimony of the mode of his martyrdom; the left hand resting on the right wrist.

MATTHEW (2d statue on the left), the publican, with the emblematic money-bag at his feet, holds a tablet in his hand, and appears lost in meditation upon the great theme which, in his office of Evangelist, he is about to commit to record. An angel, emblem of his evangelical mission, kneels at his side.

BARTHOLOMEW (3d statue on the right), holds in his right hand the knife, emblematic of his death, inflicted according to tradition by the orders of Astyages, the Armenian King.

JOHN (3d statue on the left), raises his face in adoration, full of that sweetness of expression which we ever associate with "the beloved disciple." By his left side is seated an eagle, the emblem of his angelic mission.

JAMES (4th statue on the right), the brother of John, is about to set out on his apostolic journey. He carries the pilgrim's staff on his right-hand, and on his back the broad-brimmed hat of the Palmer.

JAMES, SON OF ALPHEUS (4th statue to the left), supports his left-hand on a staff. The right-hand rests on the left arm. Beneath his flowing locks is seen the mild countenance, bearing that resemblance which this Apostle is said to have had to his divine Master

THOMAS (5th statue to the right), holds in his left hand the square, as a symbol of his doubting mind. His right hand supports his head.

PHILIP (5th statue on the left). This aged Apostle, borne down with cares and years, carries in his right-hand a cross of cane.

ANDREW (6th statue to the right), holds in his left hand a scroll of parchment, bearing on his right arm the cross of his martyrdom. Lastly—

THADDEUS (6th statue to the left), joins his hands in adoration. His left arm supports the executioner's axe, by which he bore testimony to his Lord in the death of a martyr.

Of the Apostles, those of St. Peter and St. Paul were alone entirely modelled by Thorwaldsen himself. The Christ and all the others were modelled from Thorwaldsen's sketches by his pupils, and only *finished* by himself.

The St. James was, of all the group, the great Sculptor's favorite.

The open space beneath the dome of the Crystal Palace is occupied, in the centre, by an equestrian statue of WASHINGTON, by Baron MAROCHETTI, of Piedmont, but now, we believe, resident in London. It is a model in plaster of colossal size, and proposed to be executed in bronze. Baron Marochetti has designed other equestrian and colossal statues; one of the Duke of Orleans, which formerly stood in the square of the Louvre, and another of Richard, the Lion-hearted king of England, which was exhibited at the World's Fair, and was honored with a Council Medal.

The Washington has received the place of honor in our Crystal Palace, in deference, we believe, to the admiration universally entertained for the character of our most illustrious countryman, and out of respect to the love for him which every American instinctively cherishes. As a work of Art it has not met the appreciation gratifying to an artist. Our own opinion and criticism we defer to another occasion.

In the manufacture of textile fabrics of every description, there is a wide field for the exercise of taste in the application of ornamental designs. The beauty and richness of a fine fabric receive a double charm from the excellence of the design that adorns them, while a bad or inferior one detracts from whatever good qualities may belong to the manufacture itself. In employment of the floral ornaments especially, it is a serious and common fault to aim at reproducing the flowers naturally, to represent perfect fac-similies of them, in a strong and vivid coloring. Nothing can be more erroneous, and essentially vulgar, as would be evi-

dent enough, if custom and fashion did not often blind our judgment. We are glad to engrave specimens illustrating a more correct and artistic treatment. The illustrations on this page are selected from the contributions of Messrs. Craven & Harrop, of Bradford, Yorkshire, who are manufacturers of silk and worsted, cotton and worsted, and worsted, damasks. All their goods are woven by steam power, and are brought to a high degree of perfection. The design engraved on the left of the page is wrought in cotton and worsted, the one adjacent is in the same material; and the design at the bottom is executed in silk and worsted.

We give an engraving in outline of THE DANCING GIRL REPOSING, by W. C. MARSHALL, A. R. A. The statue was executed in marble for the Art-Union of London, reproduced in statuary porcelain, and issued as prizes to

their subscribers. The figure is well modelled, and the attitude and drapery indicate very completely the idea of repose.

THE FIRST WHISPER OF LOVE is another characteristic

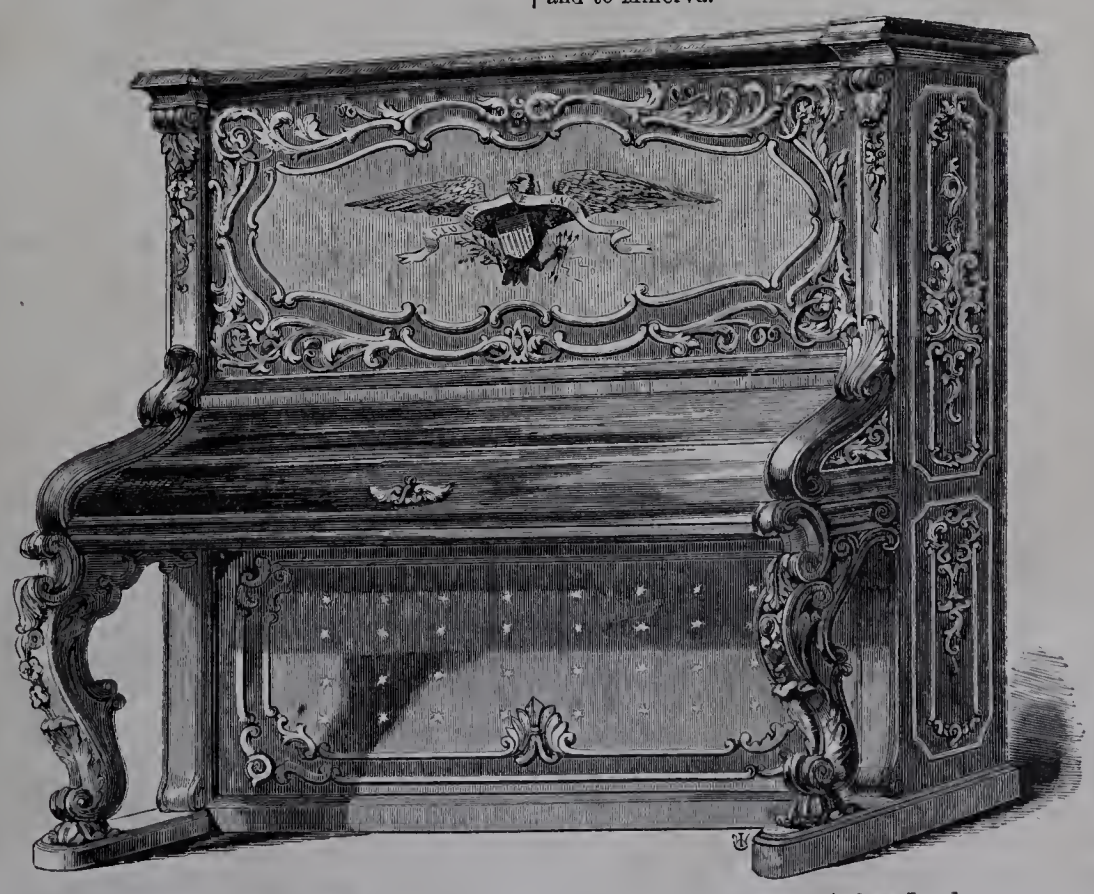
work. The young girl who bends her head coyly, but not unwillingly, to hear what Cupid has to say, evidently does not know what manner of guest it is she entertains, or see the arrow which he holds ready to pierce her unsuspecting breast.

It is seldom that we meet with fine workmanship and beauty of design united so harmoniously as in the CLOCK CASE, contributed by Mr. THOMAS SHARP. London. The design is highly poetical. Time, with his ancient

symbols, sits above and watches the evolutions of morning and night. The former is symbolized by a winged figure crowned with flowers, who bears in one hand the torch of Aurora, and with the rosy fingers of the other, scatters light upon the dewy earth. The figure of night bears a sleeping infant in her folded arms. Beneath is perched the cock, whose clarion

> With lively din,
> Scatters the rear of darkness thin.

Opposite is the solemn bird equally consecrated to night and to Minerva.



The UPRIGHT PIANO, engraved here, is exhibited by WILLIAM STODART & SON, London.

The Boar's Head, in bronze relievo, and the casting beneath it, from a specimen of Crassula portulacöides, are exhibited by Clemente

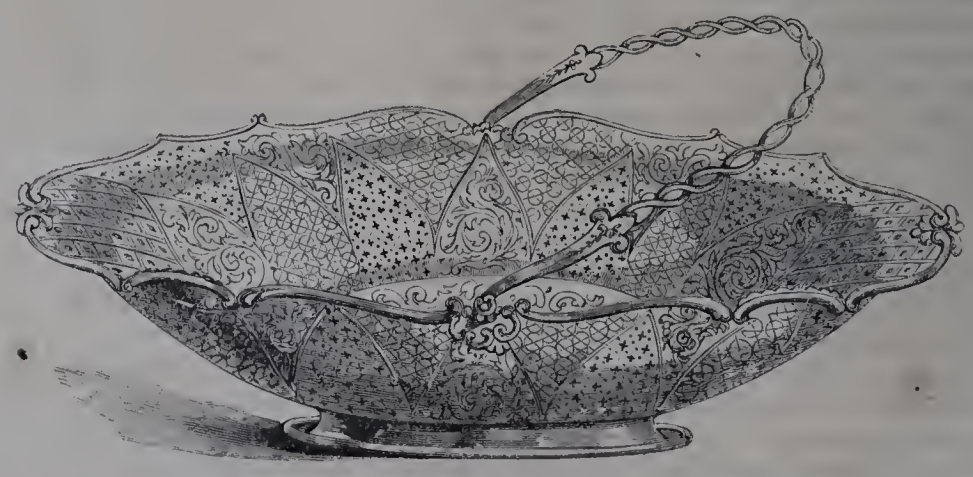
Pappi, of Florence, Tuscany. The moulds of these castings were formed directly from the natural objects which they represent, and have

not been subjected to any finishing process. They exhibit great skill in the management of the materials.

We again recur with pleasure to the attractive contributions of silver ware by Mr. Angel.

The centre piece which we engrave represents the Halt in the Desert of a party of Arabs beneath

the grateful shade of a Date palm. It is thirty inches high, contains 400 ounces of silver, and is valued at $1,750. At the foot of the page we engrave a Silver Basket, contributed by



the same house. It is beautifully wrought, and pierced in imitation of antique silver ware, and surrounded with a chased edge.

ART.

THE Department of Fine Arts in the Exhibition will do us the great service of showing us our position in relation to that of the rest of the world. Genius, history proves, is not hereditary. The children of a king are not necessarily kings: nor the heirs of a painter, artists. Nor has Art any preference for particular times or countries, being a universal fact of human development. But the aspects and forms of Art are as different as the spirit of different ages and climates. It need be no shame to us that we have not originated a style of architecture, nor a school of painting. For Art is strictly related to the circumstances of life that surround it. It is the application of beauty to use. The perception of beauty, indeed, is quite independent of use. But, since there is nothing superfluous in nature, use will always be found beneath beauty.

That Art, therefore, will have its proper place in our development, is not a matter of speculation, but of science. It is not proved by the erection of Greek temples for banking-houses, or of ameliorated Gothic cathedrals for Protestant churches, but it is to be found in the thousand new aspects that belong to our new life. The Greek temple arose naturally from the study and combination of the architecture of an earlier people. It bears the same relation to the Egyptian, that the Greek character bore to that of its elder neighbor. It is, perhaps, the best, as it is the most permanent material monument of that character. The inexperienced mind would instantly infer the poetic harmony of the religion and of the intellectual development, which presided in the construction of those temples. It would be sure that no barbarous fetish rites, but a high poetic worship, had place there.

It is this strict relation of Greek Art to the Greek character that makes that Art so eminent and complete. The same thing is true of Gothic Art in Germany, which is equally the elaborate and appropriate expression of a peculiar sentiment and form of life.

The essential point seems to be, the existence of some characteristic and national life. The national Art will be the expression of that life in the various moulds into which it casts itself. A maritime nation, the soul of whose prosperity and interest is commerce, will build fine ships. An inland people, who depend upon safe and prompt intercourse with others, will show magnificent roads, bridges, and aqueducts. Each country and century will work in its own way. In the degree that the composition of the people is eclectic, so will be the spirit of their career, and so necessarily must be their Art. The Art of France, for instance, is *bijouterie*. French pictures, French statues, French architecture, are merely copies and echoes of others. They are infected by what we call "Frenchiness," by which we mean that they are works indigenous to another feeling and development than the French, which the French has merely touched, without essentially changing—certainly without improving. But the case is very different with the matter of *bijouterie*. Now this department is peculiarly French, and therefore it is France that gives the name to it.

The American character partakes of the same eclecticism, and we must look for it in American Art. It will show works of every spirit and age; but its distinctive works of Art will belong rather to the department of the useful than of the fine. Scarcely in Greek sculpture are there finer works than some of POWERS' busts and statues; yet, just in proportion as his work is excellent, it is not American but Greek. We may erect bronze figures in memory of our great men; but neither the idea nor the execution are peculiarly our own. But a yacht that outsails all other yachts, a caloric engine, and a magnetic telegraph, are achievements not possible in Rome, or Greece, or mediæval Europe. We do not mean to decry every thing but the spinning jenny and the locomotive. On the contrary, it is in an eclecticism, or the union of various excellencies that distinguishes our national character, that we find the best reason for believing that we shall in time exhibit not only what is peculiar to ourselves, but what is best in many developments; that as a rich mind borrows from all times and countries, the graces of their genius, and yet does not sacrifice to them the integrity of its own, so we shall incorporate what is characteristic of others with what is essentially our own. Because we build ships well, it is a pity we should have no pictures; and because the Gothic architecture is not indigenous with us, there is no reason why we should have unhandsome houses.

We look to this Exhibition, therefore, to indicate the quality of our genius for the Fine Arts, as distinguished from the useful—terms which are more convenient than accurate, especially in a country where, as we apprehend, the useful will be the fine. As civilisation advances, the sphere of Art enlarges. It regards not only the exterior form of the house, but the details of the interior. It is to be sought in the harmonious blending of the whole. The forms of the furniture, of the nameless devices of comfort and luxury are all considered by it, and all in reference to a general effect. The quality of the influence thus exercised, is much too subtle to be exactly appreciated. It is not possible to determine just how much it benefits a man to see an exquisite vase, or to hear a fine strain of music. But it is very easy to perceive that he who is subject to the constant influence of beautiful forms, is in a fair way to have beautiful feelings.

There are few spots more pleasantly remembered than the gallery of vases in the Vatican. It is a region of purity, and grace, and exquisite thought; an air of cool repose pervades it. But the visitor, as he hurries toward the cartoons of RAPHAEL beyond, pauses amid these lyrics of grace, and finds that they are only the forms of useful objects. The form feasts his sense of beauty as the vases themselves served other and more material uses. And when he has left them, and confronts the cartoons, he finds that they, also, are but curtain-designs drawn by RAPHAEL. So, in what we are accustomed to call the highest and most rigorous Art, is the plainest use hidden in beauty. How then can we doubt of our own proficiency, if we see that Art itself is, really, not a whim or a caprice, but a necessity?

It will be our duty in recording the Department of the Fine Arts in the Exhibition, to insist rigorously (where we do more than describe) upon the obvious principles of simplicity and truthfulness. Irrelevance in a work of Art, as in all other modes of expression, is deformity. It destroys the force of the effect by distracting the mind. Simplicity may be as rich as imagination can make it. A superb queen in diamonds, who is so beautiful and queenly, that the diamonds only emulate afar off the lustre of her eyes and the splendor of her presence, is as simple as naked Eve in Eden. The effect is deepened by the ornament. Beauty, when unadorned, is certainly not adorned the most: for beautiful effects belong naturally to beautiful persons only, as the most majestic of temples were erected in honor of the gods. Simplicity and propriety are the canons of correct judgment in Art. We shall endeavor to conform our criticisms to them.

GLASS PAINTING.

THE visitor to the Exhibition will see in the windows of the galleries numerous specimens of painted glass, the work of both foreign and native artists. On a future occasion, we shall present copies of some of these designs among our illustrations. As the principles and history of this beautiful art are little known in the United States, we take occasion to invite attention to the following sketch of its history and practice.

The art of glass painting or staining is one of the earliest of those decorations which are still retained in modern architecture. Its early history is confused and often contradictory, but as far as we are acquainted with it, the first example of this decoration belongs to the sixth century, when it was used to enrich the Basilica of St. Sophia, the famous church of Justinian, in which his successors long after were invested with the sovereignty of the East. An instance which can be stated with greater confidence is that of Pope Leo III. (A. D. 795—816), who is said to have used colored glass in adorning the windows of the Lateran. During the tenth century it was much admired and practised in Western Europe, and its processes are minutely described in the "Artium Schedula" of Theophilus, which is supposed to have been written in the following century. It was not, however, until the twelfth century that it exhibited imaginative power, and rose to the dignity of a fine art. It shared in the powerful impulse which the Crusades had then given to all the thoughts and works of Christendom, and became thoroughly imbued with the religious enthusiasm, which was the ruling spirit of that and succeeding ages. Its subjects were chosen from the Scriptures and the saintly legends of the church, and the artists who wrought them, were influenced more by a fervid love of God than by any hope of earthly fame. Under the influence of such sympathy and alliance with religious worship, the art of glass painting attained an unexampled sway over the affections of the people, and became an essential feature as well as ornament of ecclesiastical architecture. Its use therefore was coextensive with the sovereignty of the church, and its progress justified the patronage so lavishly bestowed upon it, until at the end of the first half of the sixteenth century, it reached its greatest perfection and the summit of its power. From this time onward it declined; its productions became more elaborate and historical, at the expense of the richness and brilliancy which had been their peculiar merit; in the eighteenth century the art ceased to be practised, though it was not absolutely forgotten; and in our own times, it shares in the reawakened taste for the mediæval arts, and in their revival.

The transitions in the styles of glass painting are not less remarkable than the vicissitudes of its history. In its elementary condition, it was limited to the symmetrical arrangement of pieces of glass of various sizes and colors. The combination of colors was the only charm to which this mode of decoration could lay claim, until by the study of classic models, the beauty of correct form was again recognized. This fact may explain why it was that the earliest feeling for art

expended itself in this rather than any other channel, and why, as knowledge grew and taste became refined, the art of glass painting did not maintain its place among the other arts then invented or revived. In the windows constructed before the close of the fourteenth century, figures are the occasional exceptions, and when introduced, they are little else than very brilliant mosaics, which, except by their outlines and local color, it is difficult to distinguish from the borders and background of the composition. In the Gothic paintings, which may be said to have sprung from the mosaic, single figures or groups occupy the centre and are surrounded with borders and canopies of rich and intricate pattern; but even here, the drawing plays only a subordinate part, and the outlines are heavy and rude. To produce a pictorial effect, the artist has evidently relied most upon the skilful disposition of brilliant and positive colors. Finally, the revival of the arts in the sixteenth century had its influence upon glass painting. A more delicate and correct style of drawing was adopted; the depth of the colors was increased by the use of a purer and better quality of glass; broad and graduated shadows took the place of the stiff and narrow outlines of earlier times; perspective was attempted; and unsuccessful efforts were made to imitate in a transparent material the atmospheric and picturesque effects of nature, and to rival the details and refinements of oil and fresco paintings. The mosaic paintings were carried to greater perfection than had been hitherto arrived at, and the discovery of the enamel colors still further extended the resources of the art. The use of enamels was, however, attended with corresponding disadvantages. In proportion as glass paintings became strictly pictures, their depth of color diminished; transparency was sacrificed to variety of tints, and what was gained in sentiment was lost in vivid impressions upon the senses. This wrong estimate of the capabilities of glass painting hastened its decay. It must also be remembered, that popular favor and the patronage of princes, which had been so long the exclusive possession of this art, were powerfully attracted by the masterly productions of oil and fresco painting, and by the new art of engraving on copper. By these, glass painting was finally supplanted altogether.

The decay of which we have spoken was not immediate. Its causes were busy while the best works of the art were being produced—those which have been selected by competent authority as the standards of comparison, by which all other glass paintings are to be judged. Such are the works of the Dutch brothers, Direk and Wouter Crabeth, which were executed in the middle of the sixteenth century, and still adorn St. Jan's Kirk, at Gouda, in Holland. Few things in Europe possess greater intrinsic beauty, still fewer are more wonderful in their effect upon an American than these lofty windows, whose large surfaces are glowing with the richest and most brilliant hues, arranged with artistic regard to the laws of harmony and contrast as well as richness of *ensemble*. They have always been the admiration of natives and travellers, and by connoisseurs they have been declared to exhibit every conceivable excellence of this species of art, and to be unsurpassable in execution and coloring. When Rubens visited them, he could only be satisfied by mounting a ladder to examine them closely and minutely; and one—the Sacrilege of Heliodorus—he pronounced to be of inestimable value, for which no money was an equivalent. The materials of which the windows of the sixteenth century were composed, so closely resemble those now in use, that they are for this reason, in addition to others, more justly selected as the standards of comparison. The composition of the more ancient glass is widely different, and its peculiar effects cannot be reproduced by artificially weathering the surface of recent glass, in imitation of the obscuring and corroding results of age and long exposure.

As in every other art and decoration, the art of glass painting is subject to certain limitations, which arise partly from the object it desires to accomplish, and partly from the nature of the materials it employs. The true artist will not seek fame by transcending these conditions, but while rigidly complying with them, he will show his appreciation of his art and mastery over it, by converting its obstacles into the means of his own success. The design for a painting on glass should be in itself beautiful and pleasing, and in harmony with the architecture and object of the building it is intended to adorn. Besides these points, the artist in choosing his composition will have to consider, the great distance at which it must be viewed, the brilliant and transparent nature of the materials, and the mechanical construction of the window. This, if it is not a mere toy or cabinet window, must consist of a great number of pieces of glass, which are united with lead and strengthened by an *arming* or frame-work of iron bars. A condition which would be fatal in any other kind of painting is far from being a disadvantage in painting on glass. This will be apparent when their use as windows is thought of. They are not mere decorations, but serve also to temper the intensity of the sun's rays, and shed a "dim religious light," in harmony with the solemnities of church service and the devout feelings of the worshippers. This purpose is excellently fulfilled by the division of the window into a great number of parts, whose pure deep tints disperse the sunlight, and mingle their richness with it. In the most effective works the figures and their draperies are subjected to the same treatment, and the *leading* is ingeniously made to follow the drawing and increase its effect. In many instances, the bars of the arming are conspicuous in the lights of the window, which the artist would surely have been at pains to conceal, if he had not intended his work to be a symbol or a monument, rather than a picture in the sense of the word as applied to an oil-painting. The transparency of the glass is to be carefully preserved, and its brilliancy heightened. The object of the artist is not to produce the best possible picture, but the best bright and transparent one. With this end in view, enamels are used sparingly, the coloring being mostly produced by glass colored in the manufacture (pot-metal and flashed glass), whose pure and vivid tints cannot be imitated by enamels. How much of the beautiful effect of a glass painting depends upon its brightness and transparency, may be easily ascertained by comparing some of the ancient windows with modern restorations placed beside them, in which these conditions have not been preserved. Although the latter may be far superior in composition, drawing, and those artistic qualities which make a good *picture*, they are far from being good glass paintings, and have a dark, dull, and unpleasing effect. The contrast would be much more favorable to the ancient method, if incorrect drawing and similar unintentional errors, not properly belonging to the method, but to the time in which it prevailed, were separated from its simplicity and vivid coloring.

The distance at which a glass painting must be placed from the eye of the spectator, is one of the most important limitations of the art, and requires a mode of treatment altogether distinct from that of any other species of painting. The minute details which would be possible and effective on an opaque surface, are wholly lost on the distant and translucent surface of a cathedral window, if indeed the process of burning in the colors has not already destroyed them—an accident most likely to happen.

The nice gradations of color which contribute to the harmony of an oil-painting are inappropriate for the same reason. They inevitably blend together into a single color, which, nevertheless, fails of the lively appearance that constitutes an essential charm of the art. The inexperienced artist, who bestows his labor in the elaborate arrangement of the half-tints of his cartoon, will be surprised and mortified to find that this very labor has spoiled the effect of his completed work. He may also draw this conclusion from his failure, that the best masters were not so much ignorant of the mode, as aware of the inexpediency of copying the details and delicacies of oil-painting, and that it is well to imitate the ideas of sister arts, but not their methods.

The material of a glass painting and its position exclude shadows also, or admit only such as are quite transparent. A glass painting is not, like any other, illuminated from some exterior source, but the light which makes the figures visible, shines through them. To paint an opaque or very obscure shadow under such circumstances is nothing else than an artistic absurdity, and it meets with another objection equally important, that it destroys the utility of the window as a means of admitting light into the interior—the very object for which the painting has any existence at all. We repeat that the art of glass painting does not contemplate the production of pictures in the strict sense of that word, but architectural decorations, which are employed to add a new charm to the structure, by presenting the symbol of some scene or thought in harmony with it. Even could the point of deception be reached in imitating some other method or style of art, it would not be a high merit. In this, as in all other decorations applied to useful objects or purposes, we hold it to be a sound principle, that whenever ornament interferes with or destroys utility, it is misapplied or radically wrong.

At the revival, about twenty-five years ago, of this beautiful art, its restorers divided themselves into two schools, according to their widely different views and practice. The artists of the one have adhered to the flat and simple treatment generally practised by our forefathers, and found so effective by them; the followers of the other, belonging mostly to the continent of Europe, have been governed by principles quite the opposite, and have done every thing to treat their windows as true pictures. The latter have been very skilful in the management of their materials, and wonderfully successful in overcoming what would seem to be insurmountable difficulties in imitating the delicate details and harmonies of oil-painting. But here our praise must end. Their success has not been complete; whatever softness and high finish has been arrived at in the painting, has been fatally injured, as we have before pointed out, by the harsh effect of the mechanical construction of the window, or lost in the distance at which it must be viewed. For reasons already mentioned, we must regard these works with all their separate beauties as instances of architectural unfitness, and of the misapplication of labor and materials—results which must always follow when the principles of two distinct arts are confounded together. In regard to those who have adopted the severer style of the earlier artists, we have only to remark, that it is a grave fault to associate in one work imitations of the styles belonging to different times and places. A work made up of fragmentary reproductions will always be incongruous and unpleasing, even to those who are unable to explain the cause of the effect of which they are conscious. The style which the artist professes to imitate should be reproduced faithfully, but to do this it is not necessary, as some have done, to repeat incorrect drawing and the similar unintentional errors of ignorance.

In estimating the excellences of the two distinct classes of glass painting, Mr. Redgrave justly remarks that the greater strength and durability of the ancient method should be noticed. A modern pictorial window, construeted of a single

sheet of glass, or a few large panes, may be ruined by a single careless or malicious blow, but such an accident could do only a slight injury to a work on the old method, and it could be easily and cheaply repaired. And, besides, the frequent leading, by slightly deranging the plane of the window, heightens the rich and beautiful lustre of the glass, just as the facets on a jewel multiply its sparkling brightness.

From our brief explanations of the principles of glass painting, it will be seen that its practice is surrounded with numerous and unusual difficulties. The artist cannot rely upon himself alone to realize his conceptions, but he must call the science of the chemist, and the practical skill of the glazier, to his assistanee. The difficulties are much greater when glass colored in the manufacture is used only sparingly, and numerous pigments are employed to produce the design. This style is laborious, and more or less uncertain, as will be seen from the nature of the pigments and the manner of applying them. The colors themselves are chiefly metallic oxyds, which are applied to the surface of the glass, and are incorporated with it by the aid of vitreous or vitrifiable fluxes, upon exposure to a given temperature, much lower, however, than that at which glass softens and bends. Since the colors are seen by transmitted and not by reflected light, they must, in general, possess after fusion the brightness and transparency of glass itself. In some instances, however, a half-transparency is sufficient, and such a pigment may be employed if it admits of rich coloring; and in fewer cases the art requires pigments nearly or quite opaque. They are also required to be hard enough to resist the friction of solid bodies, to be unchangeable by the action of moisture, or by the air and the gases diffused in it, and to have an expansibility precisely in proportion to that of the glass. The last property is necessary to enable the colors to accommodate themselves to the expansions and contractions of the painted plates during the process of *burning in*, as well as to those which they afterwards undergo by exposure in the windows. The polished surface of glass is not well adapted to laying on colors, a second touch of the pencil frequently removing what the first applied. This obstacle is got over by a simple and ingenious mode of painting, called by the French *peinture par enlevage*. It consists in drawing the outlines with an oil color, and afterwards painting the whole plate with a uniform coat of water colors, and when the latter have become quite dry, they are removed with a stiff brush to different degrees, as the design may require. Where the color is completely brushed off lights, are produced; half tints are seen where the removal is imperfeet, and shadows in the untouched places. In this way the ground color is laid on, and when it has been burnt in, the plate may be again painted and retouched. This method is recommended by its comparative simplicity and quickness. It is well suited to the representation of light colors on a dark ground, and of embroidery. Nothwithstanding the beauty which may be attained by the free or exclusive use of enamel colors in the hands of an ingenious artist, we cannot but think that better results might be obtained by simpler means. The finest effects of the art have certainly been produced by methods far less uncertain and ambitious, as in the so-called Gothic windows of some of the old cathedrals, from which the slanting sunlight borrows the most gorgeous and brilliant hues, blended in soft, delicious harmonies. In these windows the colors are produced altogether by pot-metal and flashed glass, and only a single enamel, a brown opaque pigment, is used to mark the outlines and the shadows.

The modern art of glass painting has little in common with the ancient methods. When the art was revived after the long neglect which it had experienced, the improvements in the quality of glass, especially its greater fusibility, made it impossible to use the old pigments, prepared for a harder material. Their composition, and the methods of applying them, were also unknown, or so imperfectly understood, that new processes were necessary, and the ever-fruitful science of chemistry was called upon to invent them. The results were so successful, that the ancient colors and methods have been equalled, and sometimes surpassed in beauty, and in every useful quality. And in respect to glass itself, the modern is far superior to the ancient in transparency and whiteness, and in whatever gives to glass its peculiar character and beauty. It is often said that the art of coloring, particularly of making the ruby of the ancients, has been lost. Such an assertion could be made only in ignorance of the facts of history and the resources of chemistry. There was a time when the manufacture of colored glass was discontinued, not because the art of making it was forgotten, but because there was no longer any demand for it. The number of metallic oxyds was never greater, and the modes of employing them never better understood than at present. It is not in the materials and mechanical resources that the art of glass painting is now-a-days deficient, if it is deficient at all, but in that exquisite taste and unerring artistic judgment, which are so manifest in the old masterpieces of the art. Many of the old glass painters had another advantage; they were architects as well as decorators; they planned and constructed the edifice, and then finished the ornaments, the glass paintings among them, with their own hands. In design and coloring they were, therefore, in perfect keeping with the style of architecture; each adorned and interpreted the other. But now the practice is reversed. The glass painter works quite independently of the architect, and not unfrequently without reference to his plans, or knowledge of them. Under such circumstances the best effects of the art are not to be expected. The incongruities which are perpetrated would be much more obvious and displeasing, if, in our churches, any thing which, by courtesy, could be called architecture was commonly known among us. The modern glass painter must remember in choosing his design that he lives in the nineteenth century, and that he is called upon to adorn the churches of Protestants, or at least of people who have no faith in saints and martyrs, and a very slight reverence indeed for madonnas and holy families. When such subjects were set up in church windows they expressed the feelings and faith of a credulous and enthusiastic age, they embodied its poetry and sentiment, and were the teachers of the people. But let the same subjects, executed with equal spirit and beauty, be placed in a modern church, and they will excite no especial admiration, and fail utterly of touching the hearts of those who see them. They have nothing in common with our thoughts and life; in fine, they do not participate in the spirit of the age. The art of glass painting can never again have the influence which it exercised in the fourteenth and fifteenth centuries, and if it hopes to receive its fair share of admiration and patronage, it will not be by copying with endless iteration the works of old masters, but by creating new designs, consonant with our faith and knowledge, while they carefully preserve the principles which have been established by experience. We cannot see why this beautiful art, susceptible of so many beautiful applications, should be confined always to churches. Its true field, and the widest range of subjects in future, will be found, we think, in the decoration of secular buildings. At least, this application is worth the serious attention of the artist.

In bringing our imperfect notice of glass painting to a close, we regret that in the present early and incomplete state of the Exhibition, the examples of the art are not yet displayed in such a manner that we can give a *catalogue raisonne*, and, of course, not a criticism upon them. This we propose to do on a future occasion.

THORWALDSEN—CHRIST AND THE APOSTLES.

THIS group was made by Thorwaldsen in the maturity of his genius, for the new Cathedral of Copenhagen; the figure of Christ for the high altar, and the Apostles for the aisles. He had already made another group for the pediment, St. John preaching in the wilderness, and for the niches of the vestibule, the great prophets. But the decorations of the interior were to be of a still higher order, transcending, as it might have seemed, the utmost reach of art. Michael Angelo had modelled a figure of the Saviour, a noble figure, full of energy and power, but with little of that serene majesty which we instinctively conceive as the chief characteristic of Christ's human manifestation, and with none of that winning sweetness which welcomed the little children, and drew the disciple, whom he loved, to lean confidingly upon his bosom. Raphael has painted him floating sublimely in the dazzling radiance of the "Transfiguration," and Da Vinci has left, as the highest effort of his pencil, a form of equal majesty surrounded by the twelve in their last solemn celebration upon earth. Thorwaldsen's task was a still more difficult one, to give to each figure its characteristic attribute, and yet, without the assistance of unity of time and action, diffuse through all, that harmony of thought and feeling which must necessarily flow from the harmonious conception of their sublime mission. Thorwaldsen, as we have already said, was in the full vigor of his genius, and this herculean task, which would have filled up the life of almost any other man, was accomplished in a few years, during which he produced several other works, which also rank among his best.

If the reader wishes to know how so much could be done within a very limited period, he must remember that Thorwaldsen's studios were filled with young men who had been carefully trained under his own eye in the manipulations of art, and several of whom have subsequently taken a high stand as independent artists. Hence, when he was about to engage in some work of great magnitude, his first step was to prepare a clay model a foot and a half or two feet high, containing all the characteristics of the finished statue. This was the invention, with him a rapid process, and no one who has not seen them, can conceive the life, and movement, and freedom of touch which he gave to these little figures. The real difficulty was now overcome. Genius had performed its part; industry and mechanical skill could do the rest. With this model before him the workman set up the figure, and began to work out the details. Every day Thorwaldsen himself would come to observe his progress. If all was right he would pass on without remark. But if there was any change to be made he would either point it out, or take up a modelling stick and make it himself. Sometimes he would become so much interested in his work that he would go on for hours without stopping. Sometimes too important changes were suggested by some casual alteration in a trifling point. The greatest figure of the group, the Christ itself, is an instance of this. Tenerani, his favorite scholar, was working upon it, and the whole figure bears the marks of his accurate and finished touch. In the original sketch the arms were not arranged to Thorwaldsen's satisfaction, and when the

figure had been set up in its colossal proportions, he became still more dissatisfied and resolved to change them. But how to do it was the point. The idea in his own mind was clear enough, but he could not hit upon the expression that he wanted in order to bring it out with all its force. Day after day he returned to alter, condemn and alter again, but all in vain. At last, one day, after he had gone away, Tennerani ventured, for the experiment's sake, to open the arms a little wider. "That is just what I want," cried Thorwaldsen the moment that he saw it, and the figure was finished, as it now stands, without any further changes. Thorwaldsen's enemies, like Raphael's, blamed him for this manner of working, and said that he had forgotten how to model; and, like Raphael, he answered them by modelling with his own hands, the corrected and most finished of his works, the vigorous statue of Vulcan. But his bas-reliefs, a style of work which does not admit of this distribution of labor, were all modelled by his own hand.

We are glad to see this group in our exhibition. To those who have never been in Europe, it affords the best opportunity they can ask for seeing how sculpture may be made to express the sublimest conceptions. Thorwaldsen was not only the greatest sculptor since the days of the ancients—for in purity of taste and just conception of the reach of his art, he was superior to Michael Angelo himself—but the greatest original genius in art that has appeared since the sixteenth century. Exhaustless fertility of invention, a careful study of nature, a perfect appreciation of the antique, a style pure, severe, free from every trace of mannerism, and yet entirely his own, give him a position which no change or caprice of fashion can effect. How he studied the antique you can see by comparing the head of the Christ with the head of the Phidian Jupiter. If you have never seen it, you will find it among the casts at the "Free Academy." Observe it well—its grandeur, its power, its serene and commanding beauty—and then go back to Thorwaldsen and see how, without the slightest trace of imitation, he has caught the spirit of Phidias. We may claim for him, therefore, the right to be studied and not simply looked at. For you see before you a work which has been accepted by all as the master-piece of Christian statuary. Look at it as such, and study it till you feel that it is. Many have been disappointed at the first sight of the Transfiguration, but no wise man ever doubted that the fault was in himself and not in Raphael. Should you fancy at first that Thorwaldsen, too, has fallen below your conception, study and wait, and as your mind expands with the contemplation, and you begin to see new beauties with each new visit, feel assured that you have made a great and important step in the appreciation of real art.

WINES OF OHIO.

THE production of wine in the United States is an industry still in its infancy, although in the vicinity of Cincinnati, it has already become an important agricultural interest. There are specimens of Catawba and Isabella wine, both *still* and *sparkling*, in the Exhibition, from several wine growers both in Ohio and Missouri, and the subject has become one of sufficient interest in a national point of view, as regards our future progress in productive industry, to demand serious attention. It is only within a few years past that this product has begun to promise such rewards to industry as to attract capitalists to make the requisite investments to produce a good wine. Mr. N. Longworth is regarded as the pioneer in this matter, both in planting vineyards and building cellars suitable for storing and ripening their products. He also, if we are correctly informed, produced the first sparkling wine from the still Catawba.

The vine chiefly depended on in Ohio is the Catawba, a native of Buncombe County, in North Carolina, where it was discovered on the banks of the Catawba River. It is remarkable for the sweetness of its fruit and the aromatic flavor it possesses. Like the other native grapes of this country, the Catawba has a hard pulp surrounding the seeds, the sweet and flavoring portion of the fruit being between the skin and the pulp. All, or nearly all, the grapes of the European continent possess a fleshy substance like a plum, and have no hard interior. The Malaga grape, so commonly sold in our markets, is a good example of the latter variety. All the American grapes possess also, more or less strongly, that peculiar flavor so well known in the wild autumnal grape of the Northern States. In the Catawba this flavor is, however, so subdued and modified, that it is generally esteemed the peculiar excellence of that fruit. This flavor is exactly reproduced in the wine made from its juice, and gives to it a well marked and agreeable perfume and flavor.

It appears to be settled by experience; 1st that no foreign grape is suited to wine growing in the United States, and 2d, that the Catawba vine is the best for this purpose which has been tried. It is an abundant bearer, yields improved crops on culture, and beside the other qualities already named, it has the power of resisting to a remarkable degree the extreme vicissitudes of temperature to which it must be subject in our unequal climate. For example, in the winter of 1851–52, on the 19th of January, the mercury sank to 18° Fh., at Louisville, in Kentucky, some degrees South of Cincinnati, and yet no harm was done to the vines by this remarkable degree of cold.

Upon the Northern banks of the Ohio, near Cincinnati, the soil and form of the ground are particularly favorable to the growth of the vine. The soil is a calcareous loam, very retentive of moisture, and resting upon the beds of the lower Silurian. The banks slope at a high angle, and rise into lofty hills. Upon these slopes, exposed to the full action of the sun during the whole day, the vines are carefully planted in terraces, and trained to short stakes placed four or five feet apart. These vine-clad hills at once recall to those who have seen them, the best portions of the wine districts of the Rhone and the Rhine, but more especially the former in the vicinity of Chalons. Most of the vine-dressers also are foreigners, Germans from the Rhine, or from Switzerland, and French from Central France and Canton Vaud, although some of the most successful cultivators are Americans. It requires six years to bring a vineyard into full bearing, although with roots of two years' growth some wine may be procured in two years from the planting. The juice of the fully ripe berries is obtained by pressure in a standing press, and is suffered to proceed at once to the alcoholic fermentation. It is stated by M. Rehfuss that the must (sweet juice) of the Catawba vine has a specific gravity of 1·090, and after fermentation 0·992–0·996. Two samples of the still Catawba were sent to the Agricultural Society of France last year, by M. L. Rehfuss, President of the American Vine Growers' Association, and a report upon them by M. Payen has been received, and is published in the Western Horticultural Review for May of this year, page 375. The examining commission were MM. Payen and Bourchadat. The report states that two circumstances require particular attention.

First, that preference has been given to the native vine. *Secondly*, that sparkling wine has been produced. The American vines do not, in France, prove good bearers, and their strong and peculiar flavor will not be readily reconciled with European palates. "The American wine samples," the report goes on to say, "particularly recommend themselves by their neat, clear color, and their ability to furnish carbonic acid, and become effervescent. The Isabella wine is of a rose color, has a peculiar perfume, contains eleven per cent. of alcohol, and an abundance of sugar. The wine gave ·52 dry residue, double the quantity of our best white sparkling wine."

"The Catawba is of a white amber color, has less of this strong, peculiar bouquet, contains eleven and a half per cent. of alcohol, and a large quantity of sugar. Evaporated to dryness it left ·61 of solid residue, or three times as much as our Chablais wines."

"No doubt the wines in America will soon be much perfected; it shows great sagacity that the native vines received the preference there, and particularly as the sparkling wines have been produced from them."

A few statistical facts, derived from an authentic source, regarding the present state of this industry in Ohio, will be valuable. The number of acres in vines already bearing fruit in Ohio is about 2000, of which 1500 are in the immediate vicinity of Cincinnati. The average product is reckoned at 300 gallons per acre. The present price of the still wine, as it is sold by the growers, is from $1 25 to $2 00 the gallon. This price makes the whole crop of this year worth about a million of dollars, to which may be added the crude tartar, the brandy distilled from the remainder of the press and refuse wine, as well as the grapes sold fresh in the market. It is estimated that in six years the product of wine will be at least five-fold the quantity named, in consequence of the large surface put under vines this year, stimulated by the present high price of wine. It will be seen that no crop which can be raised on an acre will bring more money than the vine at the prices named. The manufacture of cream of tartar is also destined to be an important additional source of income.

This year four commercial houses in Cincinnati have prepared, chiefly from the Catawba vine, over 250,000 bottles of sparkling wine, worth $12 the dozen. It is asserted that the demand for the Ohio wines has been such that the wine merchants have found it impossible to keep the vintages on hand sufficiently long to permit them to obtain a suitable age.

For the information of those not acquainted with the mode of wine growing, it will be interesting to state that the still or dry, and the sparkling wines are both procured from the same must or juice. The only difference being, that when the primary fermentation is over, and the dry or still wine is produced, a certain small quantity of sugar candy is added to it, and a fresh ferment. A second fermentation is thus set up, during which the wine is bottled. This operation demands the greatest experience and good judgment, and can be carried on successfully only when proper cellars of large capacity are provided, within which a very equable and low temperature is maintained. During the second fermentation the bottles are inverted for the purpose of collecting a certain quantity of sediment (the result of the fermentation) in the neck. When the brewer judges that all this sediment is thrown down he adroitly cuts the strings of each bottle, still inverted, and permits just so much wine to escape as shall carry out all the sediment. The bottle is then set on its foot, and the deficiency (which is very small) supplied with still wine. A new cork is supplied by an ingenious machine, is wired in its place, and the bottle is stored on its side in the vaults to complete

its fermentation, which is to supply that torrent of carbonic acid which gives life to the champagne. A large waste always arises from the bursting of the bottles.

If the primary fermentation takes place upon the skins of the grapes, a high color and a stringency is given to the wine, as in claret.

M. Rehfuss has promulgated a theory founded on his own experiments, which, should it be supported by experience, must be of much importance to the wine growers in Ohio. It is with regard to the necessity of adding alkalies, and especially potash, to the soils on which vines are grown, for the purpose of favoring the production of cream of tartar (acid tartrate of potash) in the growing fruit. The early vines of Ohio were very acid, and on examining them with a view to ascertain the cause, M. Rehfuss found that malic acid was present in undue quantity. This organic acid forms very soluble salts, and does not precipitate by alcohol, while tartaric acid does the reverse. On a chemical examination, the soils were found deficient in potash salts, as compared with the soils of European vineyards. Potash salts were added to the soil of a certain vineyard by M. Rehfuss; the wine of that year's growth was found to be of a superior quality, less acid, and to form a largely increased quantity of cream of tartar. This is a very interesting problem in agricultural chemistry, and should be confirmed by the most careful experiments.

From what has been stated, it will be seen that the growth of wine in America is likely to become an industry of great importance. It is already much greater in value than was the growth of cotton at the time of Jay's treaty. It is also a culture requiring a superior degree of skill in all its branches, and, of course, calculated therefore to elevate the agricultural profession. As respects the moral influence of this culture we have nothing to say in this place, save to recall the familiar fact that the wine-growing regions of Europe are remarkable for their temperance, such a thing as habitual drunkenness being almost unknown.

Although this culture is now confined chiefly to the vicinity of Cincinnati, it is not necessarily so. Large districts in Indiana, Illinois, Kentucky, Missouri, and other Southern and Western States, will be found to have eqnal capabilities of soil and climate. Indeed, it is true that the largest number of exhibitors of American vines in this Exhibition are from St. Louis, Missouri, but we have less definite information respecting the extent of the culture there. Great improvement may be expected in the variety and quality of the vines from new discoveries of native species yet unobserved, and more, perhaps, from the hybridization of those already known.

WHITWORTH'S MEASURING MACHINE.

THE measurement of so small a quantity as the millionth part of a linear inch is an achievement which must appear impossible, until the simplicity of the means and their easy manipulation are witnessed. We have seen Mr. Whitworth's apparatus used in his own hands, and propose to describe the machine and its use, and hope to do so in terms so plain as to be intelligible, without a figure, to persons not familiar with mechanics.

It is well to state that this machine is the result of a long series of experiments to the end of producing *exact* copies of the standards of length. The difficulty of meeting this problem in a precise manner can hardly be conceived of by those who have not given the subject their attention. Even in the daily practice of machine-shops, and especially in the construction of philosophical apparatus, and of machines for accurate purposes, it has been hitherto almost impossible to obtain parts of a given exact size. No rule, or scale, of one workman or shop, is an exact copy of those in use by another. The *thousandth* part of an inch, or even the one hundredth part, is a quantity quite too small for accurate admeasurement by the means heretofore in use. At the present time, in many important trades, it is necessary to send the sample itself in giving the order, because the manufacturer is not in possession of any means to enable him to ascertain, and therefore to express its size.

Now, Mr. Whitworth's machine exactly meets this difficulty, and supplies the workman with means of the most practical character to remedy it.

The yard is an arbitrary standard of measure, derived from the early days of civilisation in England, and like its congeners, the foot, the grain, the pennyweight, &c., carries with its very name the evidence of its barbarous and unscientific origin. The Anglo-Saxon mind is so deeply conservative, that it liberates itself from the shackles of conventional usage (however unreasonable) with extreme slowness, or not at all. Hence the whole system of weights and measures, both in England and in America, remains, in spite of the efforts made by Astronomers Royal and scientific Commissions to render it exact, rather a monument of past ignorance than a well-digested system of decimal parts all referable to some simple and absolute unit, capable of verification by means wholly independent of original errors in an arbitrary standard. Such a system of decimal parts was adopted by the French, and has become the language of scientific expression in all countries, without reference to the established standards in vulgar use. But we shall on another occasion have more to say upon the subject of standards of weight and measure. We alluded to the matter at present only to say, that in the determination of exact lengths, two modes of practice have been employed. One is to make the standard bar of greater length than the measure of the yard, for example, and then to represent the exact yard-measure upon it by lines of great delicacy, to be observed by a microscope, and drawn at distances corresponding to different temperatures. The other mode is what is called *End Measure*. In this method the box is designed to have the exact length as measured from the polished faces of its ends, by pieces rebutting against them. In this method also the variations of temperature are estimated by means of lines drawn upon the body of another bar, to which the rebutting pieces are attached in the manner of a gauge. The latter mode of measurement was adopted by the celebrated astronomer Bessel, for the production of the Prussian standard, and his apparatus for the purpose was exhibited at the Great Exhibition in 1851. The governments of Russia, France, Prussia, the United States, and several other nations, have adopted the use of End Measure for the production and verification of their standards. Those who may be disposed to inform themselves more accurately on the mode of applying this principle to the verification of standards of length, will find in the May and July numbers of the American Journal of Science, a lucid and detailed account of the means employed in producing the platinum Standard Metre, lately presented by France to the United States. This metrical standard is also to be seen in the Crystal Palace among the instruments of the Coast Survey, exhibited by the distinguished Superintendent of that body on behalf the United States government.

But to return to Mr. Whitworth's machine. In it he has also adopted the principle of End Measure. Two sliding bars of square steel are placed in the axis of a block of cast-iron, scarcely more than a foot in length. They are so connected with screws moving with great accuracy in the axis of each, that they may be approached or withdrawn at pleasure. One of them, for the purpose of explanation, may be considered as stationary. The screw which moves the other has exactly 20 turns to the inch. To its head is adapted a wheel, upon whose periphery are two hundred teeth; consequently one of the spaces upon this wheel corresponds to the $\frac{1}{4000}$ part of an inch (20+200=4000). Now the worm which moves in the teeth of this wheel is also provided with a graduated circle of two hundred and fifty divisions, and as one entire revolution of this last wheel is equal to the $\frac{1}{4000}$ of an inch in the motion of the horizontal bar, therefore its revolution through the space of *one* of its divisions will correspond to only one two hundred and fiftieth of that quantity; and, as two hundred and fifty times four thousand is one million, therefore each division of the motor wheel registers the MILLIONTH of an inch in the motion of the horizontal bars.

All this seems very simple even in the statement, but it is abundantly more so in practice, provided, of course, that the greatest accuracy is observed in the construction of the several parts of the apparatus. It may not, however, appear so plain to one who has not seen the operation of the machine, how it is possible to arrive at any adequate expression of the results by visible mechanical means, and without the use of a microscope to note the advance and retreat of the moving bar. Practically, however, this is accomplished by the most simple means. Suppose that we have a standard block of steel measuring exactly an inch, and that it is proposed to produce an exact copy of this standard. It is necessary of course to possess the means of its exact measurement. For this purpose its end faces must be reduced to the most perfect parallelism and the highest finish. It is then laid on the bed of the machine, and one of its ends brought into contact with the fixed bar. Here comes in the simple and efficacious means of determining the point of contact between the free end of the standard and the face of the approaching bar. For this purpose a little block of steel is provided, called a "*gravity piece.*" Its faces are strictly parallel, and very perfectly polished, and it is provided with two slender arms, by which it may be conveniently handled. It is laid between the approaching faces of the standard and of the sliding bar, and when the approach becomes apparently very close by the slow onward motion of the screw, the gravity piece is raised by its handle from time to time, and let fall again. As long as it falls between the two approaching faces without obstruction there is still sensible, though not visible space, and further approach is warranted. Suppose, now, the motor wheel reads on its graduation 240 degrees, and the gravity piece in that position first falls slowly and gradually down between the approaching cheeks, then the motion of the wheel to 241 degrees binds the gravity piece, and it remains fixed wherever it may be placed between the adjacent surfaces. The reflex motion to 240 releases it again, and it falls under the influence of gravity. Now the difference between these two quantities has already been shown to be the one-millionth part of an inch. And thus the requirements of the problem are met, and for the temperature of the observation, the dimensions of the standard are fixed exactly and absolutely. To produce a copy which shall fill exactly the same space is a work requiring time, and skill, and patience, but in no higher degree than these requisites may be applied by a multitude of good workmen. It will be observed that the graduations of the motor wheel supply the means of accurately measur-

ing the differences, and of restoring the machine after each trial to its original point. It is almost needless to add that when accurately adjusted, this apparatus is a most delicate thermometer: if, for example, when it is brought within two or three millionths of an inch of its adjustment, no part of the apparatus, near the points of measurement, or the standard or trial piece, can be touched never so slightly by the finger without at once producing an expansion from heat that will fasten the "gravity piece." Great caution is required to avoid error, from this source, and the measurements by this apparatus must be carried on in an apartment of constant temperature, and with numerous precautions to prevent the heat of the body of the experimenter from interfering with the results obtained.

The practical value of this apparatus to mechanics cannot be over-estimated. By its means, Mr. Whitworth is enabled to supply workshops with graduated gauges of size, whose accuracy is absolute. These gauges are now the adopted standards of the English government in all their dock-yards and machine-shops; and the same have been also adopted by all the great engineering establishments of the United Kingdom, and by them all screwing tackle and other important parts of machinery have been regulated. We shall take another occasion to refer to Mr. Whitworth's important improvements in screwing apparatus, and to his mode of producing plane surfaces of absolute accuracy.

In conclusion, it is sufficient to say of the apparatus now under consideration, that it furnishes also the easy and certain means of producing as many identical copies of the standard measures of length as may be required for all the cities and county towns in the land, and that such a series made in different metals, as for example, in copper, steel, silver, and platinum, ought to be easily accessible for verification of standards in every important manufacturing district. A machine of similar construction, but of a less degree of precision, might be added to every engineering establishment for the actual measurement of important parts. When it is known that the greatest degree of accuracy heretofore attained by the comparison of linear measures has been the sixty-thousandth part of an inch, it will be understood that there is considerable latitude allowed between this infinitesimal quality and the millionth of an inch.

It may serve to give a notion of the quantity expressed by the $\frac{1}{1000000}$ of an inch, if we make one or two statements. The paper on which this article is printed is about 4000 times as thick as the millionth of an inch. Ordinary thick note paper is about $\frac{1}{100}$ of an inch thick, i. e. 100 sheets would measure an inch. One million sheets of such paper if piled on each other would tower a hundred feet above twice the height of the cross on St. Paul's Cathedral in London.

The curious reader, who, after seeing this article, may seek for Mr. Whitworth's Measuring Machine in the English quarter of the Exhibition, will doubtless be disappointed by the appearance of a modest-looking little apparatus, under a glass cover, which he would otherwise pass unnoticed. Let him remember, then, that we must measure relative importance by results and not by magnitudes.

OPENING OF THE NEW-YORK EXHIBITION.

IT is our duty to record the fact that the Inauguration of the building of the Exhibition of the Industry of all Nations took place by appointment on the 14th of July. The ceremony of the Inauguration was rendered of national importance by the presence of the President of the United States, and several members of his Cabinet. Thus the sanction and authority of the nation were given to crown the efforts of an Association of spirited private gentlemen to whose untiring exertions we are indebted for the existence of the American Exhibition of 1853. We shall not pursue the supererogatory task of repeating, what has been well and fully said by the daily journals, in every possible detail, of this peaceful gathering and international jubilee. The proceedings of the hour were in harmony with the simplicity of republican manners.

Upon an elevated platform, and in presence of the commissioners and representatives of domestic and foreign governments, the officers of the United States Army and Navy, and numerous persons of distinction, the President of the United States, in his civil capacity, was received by the President of the Association.

The ceremony was opened by an inaugural prayer by Bishop Wainwright, of New-York. After which Mr. Sedgwick addressed President Pierce in a short congratulatory speech, expressing the obligations of the Association for his distinguished courtesy in consenting to honor the occasion by his presence.

To this welcome, President Pierce responded, in a manner the most hearty and cordial, approving of the purposes of the occasion, and drawing from the inspiration of the moment those aspirations for the universal peace and brotherhood of nations, which were so natural to the occasion.—The beautiful dome seemed almost to rise in its airy lightness as the solemn measures of that glorious tune, "Old Hundred," swelled in joyous praise from a thousand voices. Then followed the triumphal pæans from the martial instruments, and the formality of a state ceremonial insensibly melted down into the hearty personal congratulations offered by thousands to the chief Magistrate of the United States.

The remaining hours of the day passed rapidly in surveying those portions of the Exhibition already prepared, and in witnessing the active preparations for its early completion. None were admitted on this occasion but invited guests, exhibitors, and holders of season tickets. It was estimated that ten thousand persons were present. All were amazed at the rapid changes which the last few days, and especially the last twenty-four hours, had made in completing the preparations of the Exhibition. The decoration of the interior of the dome, from which the scaffolding had been removed only that morning, excited universal admiration, as well for the beauty of its effect as for the short space of time in which it had been completed. The parts of the building unfinished on the day of the inauguration were the new wing and its appendages, extending the entire length of the Croton Reservoir. In this wing are to be arranged the machinery in motion, and models of machines not in motion, the mineralogical and mining cabinets, the picture gallery extending the whole length (451 feet by 21) over the machine arcade and the refreshment-rooms. Undoubtedly the general effect and impression of the whole Exhibition would have been far better if it could have been entirely ready in all parts before the day of inauguration. But this was impossible; unexpected and unavoidable delays arose in construction: and we may add, the Exhibitors themselves—many of them from far distant countries—were fully as much in arrear as the building. Indeed, at this present moment (July 30th), numerous important shipments of foreign goods are still on the Atlantic. The Great Exhibition in London, although (and this was its greatest wonder) opened on the day appointed, was not in order until August. The Dublin Exhibition of this year has the same history. We shall see whether French system and skill can show us a better example in 1855.

The hand Catalogue of the Exhibition and the first double number of the Illustrated Record were distributed on the day of the inauguration, and the printing presses were actively throwing off the sheets of the Catalogue.

On the 15th of July, the New-York Exhibition was thrown open to the public, and will remain open as long as the season will permit. The question is often asked if it will be reopened another season. To this inquiry no definite answer can as yet be given.

On the evening of the 15th, the Association entertained the President of the United States, his Cabinet, the representatives of foreign governments, the Commissioners of Great Britain, the Domestic Commissioners, and numerous invited guests, at a sumptuous banquet at the Metropolitan Hotel. Great good feeling animated the occasion, and numerous speeches were made by the distinguished gentlemen who responded to the several sentiments announced. Without departing from the strict line which we have drawn for ourselves, between the record of this exhibition and the daily journals whose duty it is to reproduce every detail of passing events, we do not hesitate to give, from a copy corrected by its distinguished author, a part of the speech of Sir Charles Lyell in reply to a toast on this occasion complimentary to the English Commission.

"Gentlemen:—This is the fourth visit which I have made to your country, and it is only by returning, after intervals of a few years, that we can mark the wonderful progress which the people are making in knowledge, power, and general prosperity. It is indeed a cheering sight for any foreigner to witness—I say a foreigner, but wherever I have travelled in your country, whether mixing with men engaged in the same scientific pursuits, or when I was only known as a traveller, I have never been allowed to feel myself a foreigner. Yet, strange to say, this is the first time I have ever visited the United States without finding the whole Press, and sometimes Congress, engaged in the discussion of exciting political questions, which seemed to endanger the amicable relations between this country and my own. In 1841 and 1842 there was the McLeod case, and no small agitation among the New-York and Canadian borderers. Then, in 1845–46, there was the Oregon boundary question, which lasted during my whole stay, when I saw the walls of this and many a western town and city placarded with 'fifty-four, forty—or fight.'

"After an interval of six years, I returned in 1852, and found what would be termed on the African coast a "war palaver," going on about the fisheries.

"Some timid friends warned me, before starting from Liverpool, not to run the risk of geologizing at the foot of the sea cliffs of the Bay of Fundy, lest a stray cannon shot from one of the contending squadrons should put an abrupt termination to my geological labors. By that time, however, I had begun to have faith in the peaceful issues of British and American negotiations, and was not easily alarmed. Now, at last, I come and hear no sounds but those of harmony and peace. We, at least, who are engaged in this Industrial Exhibition, may regard ourselves as members of a great peace association, though few of us may indulge any sanguine hopes of the future cessa-

NEW-YORK CRYSTAL PALACE.—INTERIOR No. III.—THE INAUGURATION.

tion of wars. Would that we could follow the noble example set us by the greatest people of antiquity, who gave a safe pass to all who attended the Olympic Games, and more especially to the Envoys or Commissioners sent to represent each State.

"War was not allowed to interfere with the celebration of those festivals, and the truce lasted for a month. I have often wondered, when reading the history of those olden times, that the Olympic Games should have endured for eleven centuries, and that so many of the leading statesmen and lawgivers of Greece should have attached such importance to them, as to award peculiar honors to those citizens who carried off the prizes. But a philosophical historian of our times, Mr. Grote, has solved this problem, and shown that there was a deeper meaning in these multitudinous gatherings than appeared to a cursory observer. It was not for the encouragement of athletic exercises or chariot-racing that they promoted these festivals. The games embraced many of the objects of our modern exhibitions. We hear of prizes awarded to the inventors of new musical instruments. We are told of the recitation of new musical compositions, as well as of poems and of histories. But besides all this, there was much of the same business transacted that is carried on here, in Wall-street, or on Change in London. There was much buying and selling, and advertising, and many commercial transactions, at a time when there were no newspapers; and all this between the citizens of states as far distant from each other, if we reckon by time before the days of steamboats and railways, as Europe and America now are. But neither the amusement and instruction afforded by these meetings, nor even their commercial bearing, were the sole, or even the principal ends achieved by such periodical gatherings. Greece was divided, like the United States, into a multitude of independent commonwealths and cities, each jealous of her state rights, each averse to centralisation, but not prevented like the members of your confederation from warring with one another. It was the aim, says Grote, of the leading politicians of Greece to give to the people of states, politically dissevered, opportunities of exchanging courtesies and hospitalities, of comparing the progress they had made in knowledge and civilisation; and above all, of cherishing a sentiment of Pan-Hellenic unity.

"Gentlemen, your Chairman, in proposing the last toast, has eulogized the illustrious Prince whom he has styled the originator of the first international exhibition—that of London in 1851; and you have responded to the toast with an enthusiasm most grateful to the feelings of every Englishman here present. The London Exhibition had a more cosmopolitan aim than that of combining together the states of one great confederacy, or two nations, politically independent, yet speaking in common the language of Shakspere. It was the first attempt to establish an exhibition in which nations differing in language, religious creeds, and political institutions should co-operate in friendly rivalry—an arena where all should compete for distinction in the application of the principles of science to machinery, and in the fine arts, and in their application to manufacturing industry.

"If a series of industrial exhibitions, on such a cosmopolitan plan, can be so arranged as not to interfere with one another, let us hope that they may acquire perpetuity, and last not only for eleven, but for eleven times eleven centuries."

The fine allusion which Sir Charles has here made to the ancient games as in some degree parallel to these modern industrial gatherings is new to us, and seems to have escaped all the ready writers, who, in lectures and essays innumerable, gave us every conceivable phase of the London Exhibition. The aspiration with which this distinguished gentleman concludes his speech will, it is certain, find a warm response in every genial heart.

THE EQUESTRIAN STATUE OF WASHINGTON.

BARON MAROCHETTI'S Washington is certainly the largest work of art in the American Exhibition, and did magnitude decide merit, this Colossus would, without doubt, distance all competition.

Without requiring our modern artists to equal the Marcus Aurelius of the Capitol, at Rome, the Phidian Horses of the Quirinal, or the Grecian Horses of the Parthenon, we have a right to expect that they will neither copy themselves, nor do violence to nature. In our judgment, Baron Marochetti has done both, of which more anon.

Baron Marochetti is a native of Piedmont, long resident in France (at Veaux, about forty miles from Paris), but now established in London. His equestrian statue of Richard Coeur de Lion, which was exhibited in London in 1851, obtained a council medal. Marochetti belongs to the French, rather than to the Italian school of art, and has imbibed largely, even if he has not exaggerated the defects of his school.

An Equestrian Statue of Washington is a fitting commemoration of him who passed so large a part of his active life in the saddle, and whose military achievements have never, until lately, received this tribute at the hands of the sculptor. Baron Marochetti has the advantage of being first in the field, at least the first whose work has been brought under the observation of Washington's countrymen. It is well known that Crawford has already modelled a colossal equestrian Washington in Rome, as the crowning figure of the monument now erecting by the State of Virginia, at Richmond, in commemoration of her illustrious sons of the Revolution. If we are rightly informed, this figure has been already cast in bronze, at Munich.

More recently the U. S. Congress has authorized the President of the United States to contract for an Equestrian Washington in bronze, to adorn the national Capitol; and, within these few days, we are informed by the daily journals, that Mr. Clark Mills has been commissioned to undertake this great national work, for the sum of fifty thousand dollars. Mr. Mills's claim to this honorable distinction over the heads of Powers, Crawford, and other American sculptors of established reputation, rests solely upon his Jackson, a work of which, as it is not a part of the American Exhibition of 1853, we are relieved from the responsibility of speaking. From this historical digression, growing naturally out of the theme of our criticism, we return to our subject.

On page 25, we present a large print of Baron Marochetti's work; and we believe that no one who has seen the original, can say that it does not do it full justice, while others may think with us, that in several important particulars, it has merits which the original has not. With the assistance of this engraving, a minute description of the statue will be superfluous. It stands directly under the centre of the dome, just where, in obedience to a proper patriotic sentiment, it ought to stand, as the boldest feature of the American Exhibition. It is in plaster, colored, to represent bronze, and the dimensions of the figures are twice and a half times the size of life.

Entering the Crystal Palace on the Sixth Avenue, the observer, as he walks down the nave, obtains the most favorable impression of this work. In that position, the group is foreshortened, and the chief faults of the composition are concealed. There is a certain commanding dignity in the figure of Washington, some spirit and movement in the horse, and that general air of grandeur which is inseparable from its colossal proportions. The head of the horse even, in this position, appears as if violently reined in for no apparent reason, although the reins hang loosely on his neck, while, on nearer approach, the defects before concealed, become more apparent. Short and clumsy legs inelegantly thrust within boots still more clumsy, huge exaggerations of holsters, and the cocked hat, unite in producing a most unpleasing effect. The countenance of the rider lacks the noble sentiment of the original, so well expressed by Stuart and Trumbull.

The action of the group, from a side view, appears both equivocal in character and bad in expression. The horse seems to be still, and yet to move; the position of the fore and hind legs being contradictory. A horse pawing the air with his fore leg, must needs keep the other three legs on the ground, and yet he raises here his alternate hind leg, as if to trot. The line of the neck is harsh and constrained, and is only less objectionable than the equivocal character of the tail. The body is clumsy despite its artistic meagreness, and partakes in no degree of the motion of the legs. Washington, it is well known, was one of the most graceful of horsemen—a true Virginian, familiar with horses from his childhood, and as much at ease in the saddle as in his chair. But here we have a stiff, ungraceful figure, braced back in the saddle, with the precision of a dragoon under the eye of his drill-master. In short, it is not a statue of Washington, but a huge man on a huge horse, which one may call Wellington, or the Duke of Orleans, or any other hero of history. We do not say that its likeness to Washington is not such that it would not be known as intended for him, for his square chin and peculiar features are so characteristic, that the potter never fails to reproduce them on a shilling jug.

As a specimen of mere execution, it has some good points and well-modelled details—a certain facility which long practice necessarily gives; though even in this we consider that there is a general character of dryness and hardness throughout it, which gives as unfavorable an idea of the artist's practical skill as the general arrangement does of his powers of invention. Throw aside all ideas of moral grandeur and personal dignity; forget that the subject is not some other hero on horseback, but is Washington; look only for minute details and petty excellencies, and we may find something to approve. But if we believe that sculpture is something more than the art of modelling; that the great thoughts which express themselves upon the human face, and communicate their grandeur to the human form, can be fitly chiselled in marble or in bronze, we shall find little in the work before us to claim our praise.

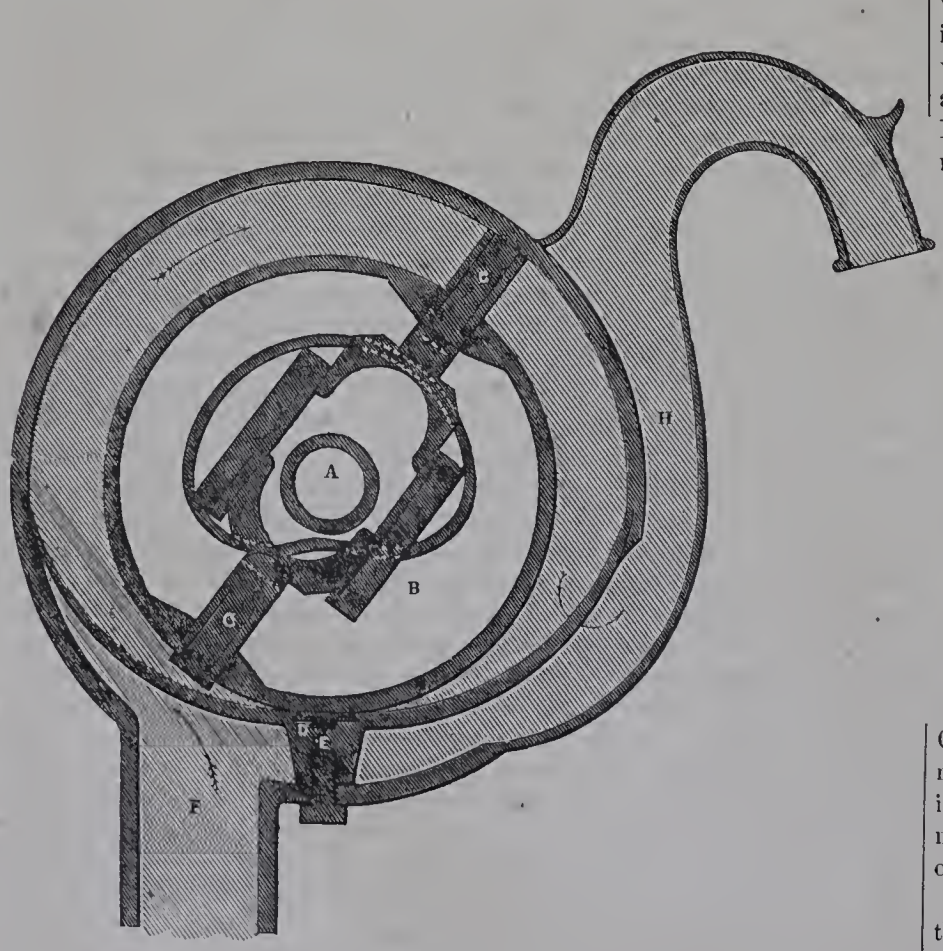
And the reason of this is evident. A monumental statue is the highest form of sculpture. It requires imagination, invention, that just conception of character which distinguishes the highest forms of poetry—a perfect command of all the resources of art, and that facility of execution which, by giving the truth of Nature to the minutest details, makes us forget the apparent exaggeration of colossal proportions. We say apparent, for in reality there is nothing more exaggerated in a colossal statue than in a description in verse. Neither Hamlet nor Lear speak the language of common life, and yet we admire them as much for their truth of thought

and sentiment, as for poetical beauty. The untrained mind must be formed to them before it can really understand them, and the untrained eye may be formed with equal ease to the appreciation of art even in a colossal statue. The artist's imagination glows and expands like the poet's, and we must let our own follow him. The artist, to move you to poetical exultation, must be a poet himself; and it is for this reason, and for this alone, that monumental statues fail constantly of their effect. No one ever asked himself any thing about proportions before Thorwaldsen's Copernicus; for he felt at once that the figure before him was a fitting embodiment of a mighty spirit which had looked so deeply into the mysteries of the starry universe. It is like Shakspeare's Hamlet, or Homer's Achilles, an adequate expression of a powerful conception; and it is from this conception that the artist, like the poet, must start. No merit of poetical imagery can cover up defects of invention, and no skill of manipulation can make an imaginary figure look a hero. We admire monumental statues; we believe them to be one of the best ways of keeping the memory of great men before the posterity for whom they labored. We would spread them over our country; we would have them in every park and in every square; we would place them in niches on the fronts of our public edifices; we would have them to look down upon in the midst of our public assemblies, speaking to us with the solemn eloquence of marble, of the great things which have been done for us.

But not in park, or niche, or hall, would we erect such monumental statues as the Washington of Baron Marochetti.

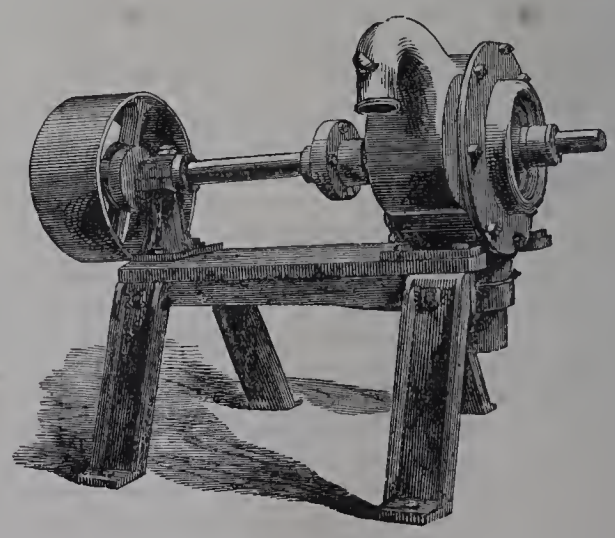
CARY'S ROTARY PUMP.

NUMEROUS inventors have produced still more numerous contrivances for throwing water by a continuous rotary movement, without the action of reciprocal pistons. The machine before us, by a most ingenious arrangement of parts, unites the seemingly incompatible conditions of a progressive rotary motion, with a reciprocal action of pistons, kept tight by the pressure of the fluid ejected. The inventor is Mr. Albigenoe W. Cary, of Brockport, Monroe county, N. Y. Not less than eleven of his pumps of various sizes, and adapted



to several important purposes, may be seen arranged in the Machine Arcade of the Exhibition. A distinct flow of water has been provided from the main in Forty second street to supply their demands, and all visitors will have an opportunity, as soon as the machinery is put in motion, to observe their performance. It is not possible from a sectional drawing only, to convey a clear notion of all the parts of this very remarkable apparatus; but with the aid of such explanations as a knowledge of its parts will enable us to supply, we hope that its principle of action will be made sufficiently clear. The general appearance of Cary's pump is shown in the elevation-view annexed. A strong frame of iron supports a horizontal shaft, on one end of which is a band-pulley for communicating power, and on the other the pump, whose delivery pipe is toward the observer. The suction pipe is seen descending on the right between the legs of the frame to the source of supply. Some idea of the disposition of the interior may be gained from the sectional view here given on a larger scale. The sectional plane passes through the median line of the pump, and parallel to the sides. The width of the pump, in relation to its diameter, is about as 1 : 3. The central drum B (of brass or iron) is attached to the axis or revolving spindle A, and moves with it. The heart-shaped cam surrounding A is fixed in an immovable position. The revolution of B therefore causes the valves or pistons C C to move in and out in obedience to the form of the cam, which constantly presses against their lower ends, guided by the slides whose position is given in the drawing. This cam is so placed, that one of the valves is constantly driven with a gentle pressure fully into the cavity of the chamber, forcing before it the water already there, and drawing after it through the suction pipe F the stream of supply, to compensate the vacuum. Each valve is in succession forced fully back into its groove, or seat, when opposite to E, which is called the *butt piece* of the exhaust and supply ways, and which is made tight by a leather packing D. An attentive consideration of this arrangement will show that each sliding valve or piston, in its turn, performs the double function of forming the vacuum, and forcing out the water previously collected in the chamber of the pump, and that as soon as the first valve or piston becomes inoperative, the position of the cam is such as to bring the second valve into full action. The direction of the flow is indicated by the arrows, and the entrance of mechanical obstructions is prevented by a perforated screen over the supply pipe F, that portion of the curve immediately over F being pierced with numerous holes. Should an obstructing object enter the pump box, however, it is immediately ejected by reversing for an instant the motion of the machine.

The cam and some other parts of this apparatus have been used before in other rotary pumps, although not combined in the same way. But the peculiarity which insures its originality and success is yet to be mentioned. It is the peculiar, efficient, and very simple manner in which the pistons are packed, as well as the mechanical construction of the revolving drum B, to insure at once easy motion, and to cut off the access of the external air. To compass the first object, the walls of the valve slides are pierced by several small holes, through which the revolution of the drum forces the water into an interior cavity, where it presses equally and gently upon the underside of the leather packing, with which the contact surfaces of the pistons are faced. These pieces of leather slide into dovetailed grooves provided for them, and may be fitted anew in a moment with no other tool than a sharp knife. We remember no contrivance of a mechanical nature which strikes us as more admirable, than the mode in which Mr. Cary has packed his sliding valves so as to insure ease of motion, perfect tightness as a necessary consequence of the action of the machine itself, and lastly,



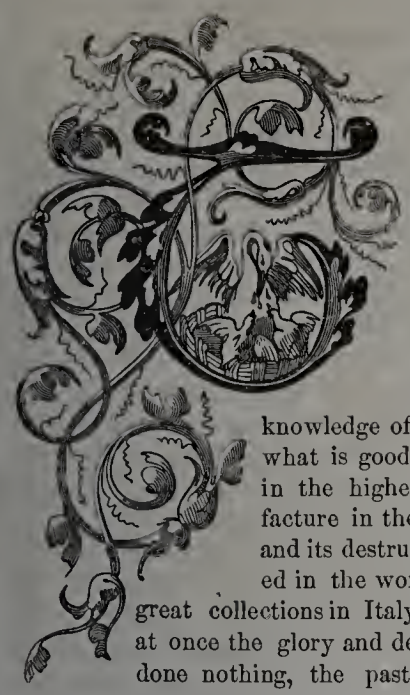
the facility with which these essential parts may, on occasion, be renewed by persons of very moderate manual skill. Where all others have failed, viz., in securing tightness, ease of motion, durability, and efficient lubrication (without resort to the usual means of lubrication), in the valvular parts of a rotary pump, Mr. Cary has succeeded in a manner seemingly to leave little to be desired. The manner in which the edges of the revolving drum are fitted into deep grooves turned in the head-pieces of the pump, would require another drawing in order to be made intelligible; and as this is not requisite for a clear idea of the chief features of the apparatus, we pass this portion of the construction without further remark.

A stream of water has been thrown in an unbroken column from this pump, through an orifice one and a quarter inches diameter, to the surprising distance of 180 feet. The pump performing this service was 14 inches in diameter, revolving 120 revolutions in a minute, and delivering 300 gallons in the same time. This, we believe, to be a higher service than has been before attained by any reciprocating pump of similar dimensions.

Owing to the easy accessibility of its parts, the whole machinery being above board, it appears peculiarly well adapted for the marine service, and we are informed that they are now preferred by shipmasters, and in marine construction.

It is asserted that with metallic packings this apparatus may be successfully used as a rotary steam engine. But we have not seen it used for this purpose, and can therefore only repeat this statement of its inventor.

THE BENEFITS OF THE EXHIBITION TO AMERICAN ART.



HERE may be much good derived by our artists and artisans from inspecting the works of Art in the Crystal Palace, and such objects comprise about nine-tenths of the articles exhibited, but the benefit to Art will depend very much upon the degree of intelligence with which the Exhibition is examined. If those who visit the Crystal Palace, with the hope of improvement, aim at nothing higher than mere mechanical copying, very little, if any, benefit will be derived from the Exhibition; but, if they go to gain new ideas, to acquire a knowledge of new methods of construction, to bring away what is good, and to avoid what is bad, the result will be in the highest degree favorable to the cause of art-manufacture in the United States. Imitation is the bane of Art, and its destructive influences may be very palpably discovered in the works exhibited in the Italian department. The great collections in Italy of the *chef d'ouvres* of the old masters, are at once the glory and degradation of the people. The Italians have done nothing, the past hundred years, but attempt to reproduce the works of the great masters of art, and have so repressed the spirit of invention, that they have at last become inferior to all other people, even as copyists. There is but one hope for Italy, and that is in the utter destruction of all the great works of Art, which now lie like an incubus on the genius of the people. The idolatrous veneration for antique Art, is not alone confined to the Italians; but it is most oppressive there, because it is there that the greatest number of the relics of Art are treasured.

Art has but two missions to fulfil, one is to be useful, and the other ornamental. Under the head of useful Art, must be classed all works that contribute to the comfort of mankind, that teach ideas, or perpetuate the memory of events. Ornamental Art is that which overlays and embellishes works of utility, and it is to this department of industry which all works of fine Art now tend. A slight inspection of the different departments of the Crystal Palace will be sufficient to show that of all the nations of the earth, the French have the truest artistic instincts, and turn their attainments in Art to the most profitable account. The whole wealth and prosperity of France lies in her ornamental art-manufactures. We import our painted church windows from Germany, our copies of antique Art from Italy, our solid and substantial cloths and implements from England, but all our ornamented goods, such as derive their chief value from the genius of the artist, we import from France. The art-manufactures of France are purely creative, their raw materials are nought. The artistic pre-eminence of the French people is not the result of an accident, nor owing to any peculiar organization of the French man, but the natural effect of wise laws which have been framed to secure this great end. Under all the changes of French government, monarchical, republican, imperial, and anarchical, the institutions for the promotion of Art have been alike fostered, and artists have been alike by all honored. The artist there, whose genius adds to the glory of the country, is considered as worthy, and as much entitled, to the honors of the government, as the soldier, or the sailor, who gains a victory; and this, too, in the most military nation in Europe; while among us, the least military of any civilised people, the artist is treated as a vagabond, and his existence is ignored by the government, while the soldier and the sailor receive the highest honors that the nation can bestow.

In French Art, it will be seen, by those who examine the painted porcelain, the bronze castings, and other works in the Exhibition, that there is no dividing line between the useful and the ornamental in Art. Nearly, if not all the works exhibited, are of the useful class, while the ornamentation which has been bestowed upon them, belongs to the highest order of artistic invention. Precisely the reverse of this may be seen in the productions of Italian Art, while, in the English, there is an excessively awkward blending of the two; the useful works are not ornamental, and the ornamental are rarely beautiful. A work of pure ornament, for the sake of ornament, is an absurdity, and against nature, as Locke says of labor for the sake of labor. It will be within the legitimate duty of the Record, to illustrate and enforce the truth of our observations by pointing to particular examples in the Exhibition; but, besides this, we must request our readers, who visit the Exhibition for the purpose of study and improvement, to bear these ideas in mind, as they go from department to department, glancing at the characteristic labor of the different peoples of the earth, who have favored us by their contributions, and we have full faith that their own observations and conclusions, will justify the truth and soundness of our remarks.

The origin of painting has been fancifully attributed to the desire of a young girl, who wished to retain a likeness of her lover, and traced the profile of his shadow upon the wall. But young girls have no need of such devices to retain the features of their lovers. If they have hearts capable of loving, they are soft enough to receive a more enduring likeness of the object of their affection, than a mural silhouette could give. It was the first office of painting to give religious instruction, by perpetuating the legendary lore of the people, as it was of sculpture, until the invention of letters and printing, and then Art began to decline until it became what it now is, a decorator and an embellisher. It is only in portraiture that Art retains any of her first great office of historian. In the high and palmy days of Art, when the great works were executed, which fill us with awe and admiration by their perfection of execution, and deep religious feeling, her votaries wasted none of their powers on merely decorative works. But now the case is different, and almost the only office Art has to fill is that of a decorator. Let us look about through the splendid achievements of Art in the Crystal Palace, and see where we can find an effort of genius which was designed for any other purpose than that of ornament. There is the superb colossal group by Kiss, the Amazon attacked by a tiger, which lacks nothing but a purpose and a meaning to entitle it to a place by the side of the Laocoön and the Dying Gladiator. To the people of this age it conveys no meaning; it is perfect in modelling, it is full of action and life, the mechanical execution is surprising, but what is the meaning of it? It is simply an ornament for the King of Prussia's palace; but, having no meaning, it fails to be ornamental, because it is out of place. Of a similar character is a marvellously fine bronze casting of a boar's head, which, for brutishness and ferocity, is quite as startling and offensive as the head of a natural boar could be, and if this object were hung up in a cabinet, it would be as terrific a bore as one need wish for. In works of this kind, of which there are a good many specimens in the Exhibition, Art suffers a degradation, and fulfils neither of the purposes for which Art is worthy of being encouraged. There is a remarkable instance of the misapplication of artistic effort, in the French department, among the beautiful examples of painted porcelain which are exhibited there. We allude to the dessert set of plates which are embellished with superbly painted portraits of the Bourbon family. These portraits are executed with the greatest delicacy of finish, and are, doubtless, copied from original miniatures on ivory; they are surrounded by imitations of pearls, and they look more suitable to be worn as ornaments for the bosoms of fair ladies, than to be used as plates for the table. It is repulsive to every sense of propriety to use such delicate works of Art to eat from, while the obvious uses for which they were intended, makes it equally repulsive to exhibit them as articles of ornament. It is one of the most obvious instances of degrading Art, by applying works intended for instruction to the lowest class of embellishment. Eating a jelly or a meringue off of the portrait of one's ancestor, and besmearing the cheeks and soft eyes of one's mother or sister with even so delicate an article of food as an omelette soufflé, cannot be productive of pleasant feelings, and we wonder that even a Bourbon could be so destitute of feeling, as to take pleasure in eating his dinner off of the faces of his ancestors. In much better taste are the examples of ornamented crockery, in which fruits and flowers are painted with such matchless beauty, as we have seen in several instances, both in the French and English dinner and dessert sets. Lady Morgan gives an account of a dinner at Rothschild's, in Paris, and describes the plates as having the finest landscapes painted upon them; but her sense of propriety did not seem to have been at all outraged by the grossness of putting such splendid works of Art to such base uses.

One of the most beautiful objects among the French bronzes, is a chandelier representing leaves and branches of shrubbery, among which the lights are placed in a natural and pleasing manner, in striking contrast to the offensive manner of sending jets of gas through the stamens of water lilies, and making flames burst out of drooping fuschias, as is the prevailing fashion. We can but hint at the many objects in the Exhibition which are full of suggestiveness to the thoughtful observer; but we shall recur to the subject again, and endeavor to direct those who, for improvement, visit the Crystal Palace, or study our engravings of the objects exhibited there, how to profit by the wealth of decorative Art which abounds in its different departments.

BOOKBINDING.

BOOKBINDING is an art much older than it is generally supposed to be. As we all know that the first books were written upon parchment or papyrus, and rolled upon small cylinders of wood or ivory, the impression is not uncommon that all books were in that form until the introduction of the art of printing. But it is two thousand years and more since Phillatius, a Greek, divided the rolled volume into sheets, and glued these together in the form which is familiar to us. The rolls had been preserved from dust and injury by being kept in cylindrical cases, and a protection for the book in its new shape was soon found to be more necessary than before. This was supplied by securing the leaves between stiff covers, probably of wood at first, and thus began the modern art of bookbinding. Soon the board was covered with leather, making in external appearance a still

nearer approach to the workmanship of our day; but it was not until the close of the fifteenth century, or the beginning of the sixteenth, that the stout pasteboard, called mill-board, which unites lightness with sufficient strength, was used as the foundation of the book-cover.

The ancient Romans ornamented the covers of their books very elaborately. Those of wood were carved; and upon some of these, scenes from plays, and events of public interest were represented. About the commencement of the Christian era, leather of brilliant hues, decorated with gold and silver, had come into use. In the Middle Ages, the monks exhausted their ingenuity, and frequently, it would seem, their purses, in adorning the covers of those manuscripts which they spent their lives in writing and illuminating. Single figures and groups, wrought in solid gold, solid silver, and gold gorgeous with enamel, precious stones and pearls, made the outside of the volume correspond to the splendor within. Less expensive works were often bound in oaken boards very richly carved; scenes from the life of Christ, the Virgin, or the Apostles, furnishing the subjects. Many still exist upon which the Nativity, or the Crucifixion, is carved in high relief.

In the latter part of the fifteenth century, and the beginning of the sixteenth, kings, princes, and wealthy nobles, expended much money upon the binding of their libraries, which were, in many cases, very extensive. Carved ivory covers, protected by golden corners, and secured by jewelled clasps were common, as were also those of velvet, silk brocade, vellum, and morocco, elaborately ornamented after designs made by great artists, and protected with bosses, corners, and clasps of solid gold. The precious stones and metals upon these book-covers cost us the loss of many a more precious volume, for they frequently formed no inconsiderable part of the plunder of a wealthy mansion in a captured city. Mr. Dibdin tells us of one library of thirty thousand volumes—that of Corvinus, King of Hungary—which was destroyed on this account by the Turkish soldiers, when Buda was taken in 1526.

Quite an era in the history of bookbinding in England was formed by the publication of the Great Bible, by Grafton, in 1539. His first edition was of 2000 copies, and within three years there were seven editions. A substantial binding was thus needed for nearly twenty thousand volumes, and from this time there was a noticeable advance in the art in England; chiefly, however, in the mechanical department; for Henry VIII. had many books richly and beautifully bound. In his reign the use of gold tooling was introduced, and the designs for some of the rolls are attributed to Holbein. Queen Elizabeth herself embroidered velvet and silk book covers, some of which were also tooled in gilt. [It may be well to say here, for the benefit of those not familiar with the bookbinder's vocabulary, that gilt tooling is what is commonly called gilding, the figures in gilt being produced by the impression of a hot tool, sometimes stamped, sometimes rolled, upon gold leaf. Blind tooling is produced by the use of the hot tool without gold leaf. The forwarding of a book is the sewing and putting it into the cover. Finishing, is the tooling, gilding, &c.]

Among the finest specimens of finishing ever produced, are those which were executed for Count Grolier, a French nobleman, who lived at the close of the sixteenth century. The patterns are formed only by the intricate intersection of graceful lines. There is never an attempt at the imitation of any natural object, although leaves of a conventional form are sparsely introduced. In our opinion there has been no style of highly ornamental binding equal to that adopted by Count Grolier, and which is known by his name. Attempts at the accurate imitation of natural objects, such as figures of men and animals, foliage and flowers, by gilt tooling upon book covers, seem very much out of place, and have never been successful in themselves. The attempts at architectural ornaments, such as the perspective delineation of a cathedral or of a railway tunnel, especially if they are ostentatiously gilt, as well as inlaid portraits or landscapes, are equally objectionable in point of taste and utility. No ornament which is not flat in reality or appearance is admissible on the cover of a book.

Since the time of Count Grolier, the French binders have maintained a marked superiority in the finishing of their work. In the last century lived Pandeloupe, De Sueil, and De Rome, who have left historical reputations for the delicacy and richness of their designs in gold. At the present day Beauzonnet, Capé, Duru, Bozerian, Simier and Lortic, are the most celebrated among the French binders. As a class they lack neither ability nor conceit. They hold themselves far above their brethren of England; and Duru once said that he should consider himself insulted if he were told that he could bind as well as Hayday. Their prices are enormous—three times as great as those of the best London binders, large as those are. The French books are remarkable for the firmness of their boards, the smoothness of their leather, and the delicacy, the richness of design, and the sharpness of outline of their gold tooling. The design upon one of Beauzonnet's, Capé's, or Lortic's books seems hardly to be stamped upon the leather, but rather to be inlaid in it. But for pleasure and convenience in use, the work of the French binders is inferior to that of the English. Books bound by the former are very stiff; that is, they open with great difficulty, and require constant pressure to keep them open.

The father of the English school of binders was Roger Payne, who lived toward the close of the last century. He bound compactly, with some taste, and always used the best materials. He did all the work upon every volume bound by him, from sewing the sheets, to gilding the edges and tooling the sides. The great modern English binders are Hayday, Clarke, Bedford, Riviere and Wright. The Remnants have a very large establishment, and bind richly and substantially. The work of Charles Lewis (now dead, we believe) is highly prized, and merits its reputation. But in the work of all these binders a poverty of invention is apparent, which diminishes their claims upon our admiration. Their tooling is coarse and heavy beside that of the French binders; and by using thicker and less compact boards they produce an impression of clumsiness. The great pleasure in the use of the work of a good English binder is found in the freedom with which the book opens, the respect which his plough has had for the margins, the trueness, squareness, and compactness of the book itself—that is the leaves—and in the rich general appearance of the volume. Splendid as the French work is, it is not always with regret that we turn from Beauzonnet or Capé, to Hayday, or Clarke, or Bedford.

In America bookbinding is eminent among the arts in which remarkable progress has been made within the last few years, and among the specimens sent to the Exhibition by one or two of our binders, we find instances of taste and mechanical skill, which would be creditable to the best European binders. We call bookbinding an art; and when we consider all that is necessary to the perfect covering of a fine book, it must be admitted to be an art; less important, it is true, but similar in kind to architecture.

The first requisition upon the skill of the binder is to put the book into a cover which will effectually protect it, and at the same time permit it to be used with ease. If he do not accomplish this, his most elaborate exhibition of ornamental skill is worth nothing; for he fails in the very end for which his services are required. It was in this regard, too, that most of our binders failed in past years. Who that remembers the hideous, harsh, speckled, sheep covers which deformed our booksellers' shelves not long ago, can forget the added torment which they inflicted upon their unhappy purchaser, by curling up palpably before his very eyes as he passed his first evening over them, and by casting out loose leaves or whole signatures before he had finished his first perusal. In those days, too, there was morocco binding, with a California of gold upon the sides; and such morocco! it felt to the fingers like a flattened nutmeg grater, seeming to protect the book by making it painful for any one to touch it. This was as useless as the humbler, though not more vulgar sheep. It would hardly last through the holiday season on the centre table which it was made to adorn. This is so no longer, and we now have several binders in New-York, and some in Philadelphia and Boston, whose work, with reasonable care, would last for centuries.

The binder's next task is to give his work the substantial appearance, without which the eye of the connoisseur will remain unsatisfied. The volume must not only be well protected but seem so. It should be solid, compact, square edged, and inclosed in firm boards of a stoutness proportionate to its size, and these should be covered with leather at once pliable and strong. Unless it present this appearance, it will be unsatisfactory in spite of the richest colors and the most elaborate ornament. Thus far the mere mechanical skill of the binder goes. In the choice of his style of binding, and in the decoration of his book, if he perform his task with taste and skill, he rises to the rank of an artist.

The fitness of the binding to the character of the volume which it protects, though little regarded by many binders, and still less by those for whom they work, is of the first importance. Suppose Moore's Lalla Rookh bound in rough sheep, with dark Russia back and corners, like a merchant's ledger, or Johnson's folio Dictionary in straw-colored morocco elaborately gilded, and lined with pale blue watered-silk, is there an eye, no matter how uneducated, which would not be shocked at the incongruity? Each book might be perfectly protected, open freely, and exhibit evidence of great mechanical and artistic skill on the part of the binder; but his atrocious taste would ensure him a just and universal condemnation. And yet there are violations of fitness to be seen daily, on the majority of public and private shelves, little less outrageous than those we have supposed. Books of poetry, and illustrated works on art bound in sober speckled or tree-marbled calf with little gold upon the backs and sides, and none upon the edges! Histories, statistical works, and books of reference in rich morocco, splendidly gilded!—the idea that the styles ought to change places, seeming never to enter the heads of the possessors of these absurdly covered volumes. But a little reflection by any person of taste, and power to discern the eternal fitness of things, will make it apparent that there should be congruity and adaptation in the binding of books. Sober, practical volumes, should be correspondingly covered; calf and Russia leather with marbled paper and edges become them; while works of imagination, such as poetry and books of engravings, demand rich morocco, fanciful ornaments, and gilding. To bind histories, philosophical works, dictionaries, books of reference and the like, in plain calf or dark Russia, travels, novels, essays, and the lighter kind of prose writing, in tinted calf or pale Russia with gilding, poetry in full morocco richly gilded, and works on art in half morocco, with the top edge only cut and gilded, seems a judicious partition of the principal styles of binding. The margins of an illustrated work on art should never be cut away, except where it is absolutely necessary for the

preservation of the book from dust, and the convenience of turning the leaves—that is at the top. It is well here to enter a protest against the indiscriminate use of the antique style of binding, with dark-brown calf, bevelled boards, and red edges. This is very well in its place; but it should be confined to prose works of authors who wrote not later than one hundred and fifty years ago. What propriety is there in putting Scott, or Irving, or Dickens, or Longfellow, in such a dress?

A better illustration of the remarks could not be produced than is to be found in the case of books exhibited by Mr. William Matthews, New-York. In this case are specimens of almost every style of binding, in its highest perfection, and most correct adaptation. A set of Pickering's edition of Milton, bound in light olive morocco, of a rich and sober, yet delicate tint, is remarkable for the squareness and firmness of its boards, the compactness of its leaves, the freedom with which it opens, the sharpness and perfect accuracy of the tooling, and its distinct and even lettering; in the last respect it is unequalled, and in most of the others unsurpassed by the finest specimens we have seen of the best binders of London and Paris. Various sets of books, and single volumes in calf and morocco in this case, claim the unqualified admiration of the experienced eye both for their forwarding and finishing.

But the principal specimen from the establishment of Mr. Matthews, is a copy of Owen Jones's Alhambra, of which we have given an engraving. This book is a large folio, filled with plates of the gorgeous Moorish decorations of the famous building, the name of which it bears. Its contents made it appropriate for the binder to give full scope to his fancy in the design for its exterior; and the result is a work of art of superb richness and irreproachable taste. The external design is foliated arabesque; graceful, though grotesque, and not overloaded, though rich in ornament and gilding. The peculiar effect has evidently been produced in this way. The book was first completely covered with pale Russia leather, and over this was laid blue morocco, out of which the design was cut, so that the figure appears light upon a dark ground; in fact, it is an *intaglio* in leather. As the Russia and morocco, though rich, needed life and fire to suit perfectly the character of the plates which give the volume its character, the principal outlines of the design are followed with a narrow strip of crimson morocco, and upon this is laid the gilt tooling, which is composed of very small circles, semicircles, dots, and lines, each one requiring one or two impressions of the tool. The effect is splendid, and the workmanship is exquisitely nice and accurate.

The inside of the cover is elaborately ornamented in a similar style, but with a different design. The forms here are not foliated, but are the results of the intersection of complicated semicircular lines. The colors and the tooling are the same as those upon the outside of the cover. In the middle is a panel in vellum, upon which is laid down a lozenge pattern in straw-colored morocco, richly gilt. The fly leaf is backed with straw-colored watered silk. The hinge is, of course, of Russia leather.

This superb volume is exhibited as a specimen of finishing; and it is deserving of particular attention that its beauty is entirely the fruit of the binder's taste and skill. Leather and gold leaf are the only materials used in the production of its splendid dress, which owes nothing to the painter and the jeweller. This is as it should be. *Suum cuique.* Let not arts be mingled. The binder who seeks the painter's aid confesses the poverty of his invention, or the inadequacy of his art. Money enough can be expended upon binding to make the outside worthy of the inside of the most precious volume, and to satisfy the profuse disposition of the lavish. The binding of this volume cost its tasteful and enterprising exhibitor $500.

Among the other books exhibited, the account books from Messrs. Root & Anthony's seem most worthy of notice. Their strength, elegance, and pliability make them models in this style of binding. There are several other cases containing bound account books, the forwarding of which is perhaps equal to that upon those of which we have spoken; but they are deformed by the splendor of inlaid vellum, and morocco gilded; thus violating the law of fitness, which we must consider as one of the first to be regarded in bookbinding, as in all other arts. Gilding and prismatic colors are out of place in the counting-room.

THE UNITED STATES COAST SURVEY.

THERE is nothing in the American department of the Exhibition, which is a more just and honorable exponent of the progress of the United States in some of the higher and more difficult departments of human knowledge, than the display of the means and results of the Coast Survey. It consists of various instruments of research, theodolites and astronomical instruments, compensating bars for the measurement of base lines, instruments for verification, a tide register, a thermometer for taking the temperature of the deepest soundings, the standards of weight and measure, and of the results of field researches, comprised in numerous engraved copperplates and electrotype copies of them, and the printed charts. These mute witnesses speak, in language clear and distinct to the instructed mind, of the progress and power of science. They have all borne their part in carrying this great work forward to its present honorable position—a position which has done much to make the name of America honored over the whole world.

The present Superintendent of the survey is Alexander Dallas Bache. His position is at once the most honorable which a scientific man can reach in the United States, and also the most laborious and responsible. The constantly increasing confidence and esteem which Mr. Bache has won from successive administrations at Washington, as well as from the people at large, and especially from the distinguished United States' officers, and the civilians employed in this service, bear the most gratifying testimony to his remarkable scientific and administrative abilities. We propose to describe some of the most interesting of the instruments and processes of the survey. A condensed statement of the history and objects of the survey will be an appropriate introduction to these notices, and for this we are chiefly indebted, by permission of its distinguished author, to a memoir by Capt. Charles H. Davis, U. S. N.

It was to be expected that a people devoted to the pursuits of commerce, and depending, in some degree, on the sea as a means of communication between distant parts of the national territory, should demand, at an early period of their history, a competent survey of their coasts and inland waters.

But a short time previous to the separation of the Colonies, charts had been constructed of the shores and harbors of North America, under the direction of F. W. Des Barres, his Majesty's Surveyor-General for the Colonies. The progress of his labors was interrupted by the Revolution. The surveys made under the personal superintendence of Des Barres still bear testimony to his skill and fidelity, and present a generally correct view of those parts of New England and the British possessions, whose rocky shores are but little liable to change. They continue to form the principal basis of the charts of the northeastern coast of this continent. In the Southern and Middle States, however, they have been rendered worse than useless, by the inconstant character of the bottoms, and the unequal merit of the originals. The surveys of Des Barres, covering a vast extent of coast, were originally deficient in minuteness of detail, and in hydrographical information; and these defects have been increased by the rapid and extensive changes in the direction, means, and wants of navigation caused by the growth of the country.

The project of a complete survey, conducted upon a uniform system, and extending over the whole coast, was first proposed by the late Professor Patterson, in 1806. It combined three objects, the astronomical determination of prominent points, a triangulation to connect those points, and a hydrographic survey based upon this triangulation. Mr. Gallatin, then Secretary of the Treasury, encouraged the project, and obtained in writing the opinions of learned men as to the best mode of executing it. He selected the plan of operations recommended by Mr. Hassler, the first Superintendent of the Coast Survey. This gentleman, a native of Switzerland, had been employed in the triangulation of the Canton of Berne, and had studied the science of geodesy under the most distinguished masters. It was exceedingly fortunate that his presence and advice here secured the early adoption of the only method of conducting a comprehensive trigonometrical survey that science approves,—the only one of which the results have a certain and permanent value.

It is only, however, since the year 1832 that the survey of the coast has been in steady and active operation. During this long interval of neglect on the part of the government, the coasting trade and foreign commerce of the country have been chiefly indebted to the indefatigable labors of those distinguished hydrographers, the Messrs. Blunt of New-York, for the means of safe navigation.

The history of the fortunes, or rather misfortunes of the survey, during the preceding twenty-five years, may be recited in a few words. A law authorizing a survey of the coast was passed in 1807, but nothing was done under the law until 1811, when Mr. Hassler was sent to Europe to procure the instruments specified in his plan. They had all to be constructed. The war of 1812, and the failure of remittances, prevented Mr. Hassler's return before 1816, and in August of that year he was appointed to the office of Superintendent. In 1818, Mr. Hassler's connection with the work was broken off, by the repeal of that part of the law of 1807 which authorized the employment of citizens. During the ten years that followed, the coast survey seems to have been forgotten by the public and by Congress. In 1827, Mr. Southard, the Secretary of the Navy, a name never to be mentioned without an expression of the high respect which ability, patriotism, and long, faithful, and valuable services must always command in the republic, took occasion in his annual report to say, that perfect surveys and charts of our harbors could not be made without the aid of the means contemplated by the act of 1807, and in February, 1828, the House directed the Committee on Naval Affairs to inquire into the expediency of carrying into effect the provisions of that act. Finally, in 1832, the act of 1807 was revised, and an appropriation made for carrying it into execution, and since that period regular annual appropriations have been made, varying in amount, but generally such as have been called for by the estimates of the Superintendent.

In 1843, there was added to the appropriation a proviso, stipulating that a board, consisting of scientific persons in the service of the Government, should be empowered to reorganize the work; and the plan presented by them, when ap-

proved by the President, was to be, and is now, the law regulating the operations of the survey. The scientific methods pursued by Mr. Hassler were continued, and it was directed that the topography should be carried so far inland as might be necessary for a proper delineation of the shore, and for purposes either of commerce or defence.

It is now understood that the aim of the coast survey is to furnish, with the utmost attainable accuracy, and in a connected and uniform manner, all the geographical, topographical, and hydrographical data that can be made in any way useful to the navigation and defence of the coast. And it is also supposed, that, in collecting these data, information will be accumulated that may become serviceable in suggesting and directing local and general improvements; such as the placing and constructing of light-houses, beacons, buoys, &c., the means of improving channels, the effect of contemplated obstructions upon harbors and tidal deposits, the suitableness of a submerged soil for building, &c. And, lastly, it is presumed that those States through which the survey passes will, sooner or later, avail themselves of the base it is able to supply, to form a correct geographical map of their own territory, under circumstances very favorable to economy and accuracy. These are the practical benefits, either direct or incidental, conferred by the coast survey.

In abstract science it has also its mission, equally useful and distinguished. It is to contribute a part of the means by which the irregularly elliptical form of the earth may be satisfactorily determined, the variations in local gravitation, their causes, and thence the internal structure of the earth, be made known, and the phenomena of terrestrial magnetism be explained. It will illustrate the astronomical problem of the tides. Its numerous meteorological records will also contribute to a better knowledge of the climates of the United States, and of the nature and action of meteoric storms, and thus be of service to the farmer as well as to the navigator.

The science of geodetics prescribes the principles upon which a survey of an extended region should be conducted. In the ordinary operations of land-surveying, the surveyor is permitted to regard his field of work as a plane surface: but the engineer who is to construct a map of a whole country, or of a long line of continuous sea-coast, must take into consideration the spheroidal figure of the earth, and present an exact delineation of that part of the spheroid upon which he is employed. This necessity controls the processes used in computation, and the plan of projection upon which the detailed results are given, whether it be called a map or chart. Both the projection and the formulæ for computation involve the higher mathematics, and require an acquaintance with the most advanced state of the mathematico-physical sciences.

The system of projection introduced by Mr. Hassler originated with Flamsteed. It is the development of a part of the earth's surface upon a cone, either a tangent to a certain latitude, or cutting two given parallels and two meridians equidistant from the middle meridian, and extended on both sides of the meridian and in latitude only so far as to admit of no deviation from the real magnitudes, such as would be sensible in the detail surveys. In this method of reducing the curved surface of the earth to a plane, the radii of curvature of the parallels and meridians, depending upon the value given to the expression for the ellipticity, and the assumed form of the globe, are important terms. For practical use, tables have been computed in the office of the coast survey, showing the length in metres of every minute and second of the arcs of the meridians and parallels comprehended in the maps. It has been found necessary to recalculate these tables since 1844, on account of the new value of the ellipticity announced by Bessel, and adopted by the present Superintendent.

The practical operations of the coast survey are classed under the general heads of triangulation, astronomical and magnetic observations, topography, and hydrography. The fundamental basis of the survey is a net-work of great triangles, the sides of which, varying from ten to sixty miles, are the longest that the limits of vision or the nature of the country will allow, and hence a mountainous region is much the most favorable for a first or *primary triangulation.* The starting line, or first side of the first triangle, called the *base line*, is measured by mechanical means, and this is a labor demanding, as much as any other on the survey, accuracy, a philosophical regard to minute details, and long previous preparation. Observing, in passing, that several kinds of measuring-rods have been heretofore used, as wood and glass, and that the apparatus of Mr. Hassler consisted of an assemblage of four iron bars, each of them two metres in length, with which he obtained excellent results, it will, perhaps, best serve to convey an idea of the difficulty of measuring a base-line, if some account be given of Professor Bache's base-apparatus.

The measuring-bars are upon the compensating system, first used by Colonel Colby in Great Britain, and by Mr. Borden in the trigonometrical survey in the State of Massachusetts; but a principle not before applied was introduced in reference to the dimensions of the bars, which is thus stated. Bars of brass and iron (the materials employed), of the same dimensions, will not, owing to their different conducting powers and specific heats, heat equally in equal times, and therefore, during changes of temperature, the system ceases to be compensating. This Mr. Bache corrected by giving a coating to the bars that made them absorb equally, and by proportioning the sections to each other, so that both would have the same temperature during variable temperatures of the atmosphere. In order to do this satisfactorily, it was necessary to make direct experiments upon the materials of the bars themselves, after having first arranged them approximately by means of the numbers taken from the books. The contact between two sets of bars is made by a blunt knife-edge and a plane of agate, and a lever of contact at the ends of the bars is corrected by a level so delicate, that several of its divisions make up a quantity entirely insignificant in the measurement. The bars are covered with a double conical case of tin, to keep the fluctuations of the temperature within moderate limits, and the bases on which they are supported are covered with several thicknesses of imperfectly conducting material, for the same purpose. The length of the apparatus is compared, before and after final measurement, with a standard iron bar that had been compared by the coast-survey office by means of Mr. Saxton's reflecting pyrometer. By this instrument, a change of the one hundred thousandth part of an inch in the length of the standard bar is perceptible.

To the preceding description it should be added, that the bars (regulated in size by the relative specific heats of the two metals) were heated above the possible temperature to which they could be exposed in use, in order to give them a set. This precaution was at first overlooked in the compensation base-apparatus of the British ordnance survey, and it was afterwards found necessary to resort to it. Those who are at all familiar with the subject will perceive that Professor Bache's application of the lever of contact and level (first used by Bessel in standards of measure) has not only greatly increased the delicacy of the instrument and lessened its complexity, but also removed several sources of error. By optical contact, and the employment of a microscopic apparatus to determine the distance between the compensation points, the measures are repeated in two different terms, each having its peculiar standard. Such was the case in the British and Indian surveys, and Colonel Everest complains of the consequent liability to error, and the burdensome accumulation of petty corrections. The remeasurement of a base of seven and a half miles, in India, differed only 2.4 inches from the first length. In a base of seven miles, Professor Bache found that the same difference might be about 0.5 inch, if all the errors were supposed to fall on the same side, which is most improbable. The probable error in remeasuring one hundred and twelve yards was less than five thousandths of an inch, and the actual resulting error in remeasuring one-third of a mile was nothing.

This may appear like refining too much, but it must be known that the lines measured by the same bar in winter and summer might differ materially in nominal length. This difference in the original base of the coast survey might be about twenty feet, and, at a rough estimate, an error of twenty feet in this place would amount in one of the large triangles, of which the sides are between fifty and sixty miles, to about one tenth of a mile.

The source of error and its correction being recognized, there is no other limit to accuracy than the possible.

We return now to the great triangles of the survey, which, as has been said, form its fundamental basis. The points of the primary triangulation are selected with scrupulous regard to all those conditions which make triangles, in the technical acceptation, good. Scattered at distant intervals over the vast field of work, they are certain guides by which the more detailed operations are conducted and controlled. Within them the space is subdivided into smaller triangles, constituting the *secondary* and *tertiary triangulations.* They bring down the work to the minute details of topography and hydrography, and these subsidiary triangulations and details, circumscribed as they are by the primary points, are restrained and corrected by them in their deviations. As an additional explanation of the necessity for this first net of great triangles, it may be well to inform the general reader that there is no instrument, however delicate in construction, that is not liable to very small errors, which the most studious attention to every disturbing influence, whether mechanical or meteorological, cannot altogether remove. Now this primary triangulation, which in a mountainous region spans the surface with giant strides, has fewer of these unaccountable errors, simply because it has fewer triangles. It is hardly necessary to add, that better instruments also are used in it. The two and a half feet theodolite, made by Simms (after Troughton's death), under Mr. Hassler's supervision, and used by him and by Professor Bache in the primary triangulation, is still regarded in this country and in Europe as a masterpiece of invention and mechanism. It reads to seconds.

Magnetic and astronomical observations accompany the primary triangulation. The latter are for latitude, longitude, and azimuth, or angular direction from the meridian.

Following the secondary triangulation in order comes the *Topography*, the duty of which is to delineate faithfully the features of the ground. It exhibits the height and contour of elevations, the shape and extent of plains, the courses of streams, all the constructions of man, and the waving and indented outline of the shores. It distinguishes the tilled land from the pasturage, and the grove from the orchard, and designates the character of the woodland. It speaks a universal language, and observes strict fidelity to nature.

Depending upon the secondary triangulation and the topography for its means

of progress, follows the *Hydrography*. In this term is included all that concerns local navigation, as the depths and character of the bottom, the direction and strength of the currents, the ebb and flow of the tides, and the information, coming under the head of sailing directions and nautical instruction, which make up the valuable knowledge of the local or general pilot. This branch enjoys the honor of announcing the nautical discoveries of the coast survey, which, though resulting from the combined operations of all, are yet brought out by its means.

In the preceding pages the plan of the survey is presented, and the general distribution of its labors is stated; it remains now to speak of the execution of the various details, and of the benefits that have been conferred by the coast survey upon science, and upon the local and general commerce of the country and of the world. In doing this it will be most convenient to keep to its actual state at this day.

On the death of Mr. Hassler, in 1843, the appointment of his successor was regarded with deep interest by the scientific men of the country. The office of Superintendent of the Coast Survey is recognized as one of the central positions of American science, and the incumbent is expected not only to be able to fulfil its prescribed duties, but to be qualified to direct his powers to the advancement of knowledge in every department of the work. How far the present Superintendent, Professor Bache, is suited to answer these expectations, to sustain the national reputation, and to promote the cause of science, may be estimated from the fact, that his appointment was solicited by gentlemen in all parts of the country, engaged in the pursuits of learning. He was educated at West Point, and since his graduation there, followed a course of physical science that has made him well kown in this country and in Europe. It is but justice to Professor Bache to say, that there is no branch of the work into which he has not been able to introduce improvements, either owing to the discoveries of the day, as in the use of the magnetic telegraph for meridian differences, or owing (still oftener) to his own great and eminent scientific attainments. This must appear in the course of these remarks, but it is quite as creditable to his administration to state, as may be done with strict accuracy, that the amount of results now obtained is double that under the former plan, for an increase of fifty per cent. in the cost.

Accompanying the primary triangulation, as an essential part of it, are the *astronomical* and *magnetic observations*. The determinations of the latitude (as well as of the azimuths) are frequent. About fifty latitude stations, and from thirty-five to forty azimuth stations, have been already occupied in the survey. A comparison of the latitudes deduced geodetically from a central point with astronomical determinations, led the Superintendent, in 1844, to the discovery of certain variations in the level, which could only be attributed to changes in form and density of the material composing the earth's crust. These variations are *similar* to those caused by the proximity of mountains; but whilst the latter have been well understood, the former had escaped notice. The numerous determinations of this element will therefore occupy an important place in the future discussions of the general form and internal structure of the earth. A similar discovery has since been made in the ordnance survey of Ireland by Major-General Colby, and appears to have been anticipated by Laplace in the opinion given by him in the Chamber of Peers, in 1817, upon the topographical map of France:—"If the latitudes of the extreme points (of certain lines) and of several intermediate points are observed, and the length of the seconds pendulum corresponding to these points measured, a great deal of light will be thrown upon the figure of the earth, and upon the irregularities of its degrees and of gravity."

Of the *magnetic observations* it will be sufficient to say, as an indication of their character, that they are made with the new instruments invented by Dr. Lloyd and Mr. Weber. The portable declinometer of Mr. Weber (perfected by Lieutenant Riddle, and manipulated according to his instructions) measures inclination, and, by a subsidiary apparatus, the horizontal force, by the method of Gauss. Fox's dip circle, with the use of the deflecting magnet, has given very satisfactory results. By means of these instruments, the *declination*, *inclination*, and *intensity* (horizontal and total), are determined in a manner that supplies all that is practically necessary, and contributes valuable additions to general magnetic researches.

Longitudes have been determined by occultations, eclipses, moon-culminations, and the frequent transportation of chronometers. Mr. Bond, the director of the observatory at Cambridge, Mass., communicates the meridian differences by chronometers between the British observatories and Boston. Two special chronometer expeditions have been organized between Cambridge and Liverpool.

All determinations of this element are referred to a principal port on the sea-coast, and are connected in the aggregate with differences obtained from Europe by chronometric and astronomical comparisons. The security against error afforded by employing persons to compute, who are disconnected with the duties of the field or the observatory, is well understood. Gentlemen in private life are engaged to repeat the important calculations of the survey, and this system, which enlarges the sphere of labor in a way not less commendable for its economy than for its other advantages, receives universal sanction.

But the discoveries of Professor Henry (Secretary of the Smithsonian Institute), resulting in the invention of the magnetic telegraph, have provided a new and more precise method of arriving at the difference between the times of two places, or their difference of longitude expressed in time. The details of these operations were worked out under the direction of the Superintendent by the late lamented S. C. Walker.

The space circumscribed by the terrestrial angles of the first order, and defined by the celestial observations that accompany them, is subdivided into a minute network of smaller triangles, constituting the *secondary* and *tertiary triangulations*, the points of which embrace and determine headlands, light-houses, beacons, churches, hills, and all conspicuous objects along the coast, that can be made useful in its navigation. They also bring down the work to the details of the topography and hydrography, and supply the bases for these branches of the survey.

It has been already mentioned, that the topography is minutely and exactly descriptive of the ground, both in form and character. The Lehman system of topographical drawing has been adopted, but with such modifications as the nature of this country exacted, in order to preserve the beauty of the maps. The slopes are represented by hachures, the strength and distance apart of which indicate the degree of inclination. In the original maps, the horizontal curves limiting the different slopes are drawn in red ink, as the draughtsman progresses in his sheet.

The scale of the original sheets is $\frac{1}{10000}$, or about $6\frac{2}{3}$ inches English to the mile. Plans are frequently executed in the field, and furnished from the office, when wanted for local improvement, on twice this scale. But the charts designed for navigators are necessarily reduced in dimension. The harbor charts are usually published on the scale of $\frac{1}{20000}$, or about $3\frac{1}{3}$ inches English, and the more general charts on that of $\frac{1}{80000}$, or about three-fourths of an inch to the mile; which last is the scale of the great topographical map of France. In all the maps, the topographical details are faithfully preserved, including height, contour, &c.

To pursue the history of the operations of the survey during each year, would require more space than can be allotted to the subject in the Record, and we conclude this sketch by a brief relation of its aggregate results up to 1851. Reconnaissance has extended over an area of nearly 37,000 square miles; and the triangulation covers 24,000 square miles. Nearly 1,200 miles of general coast line, and 9,000 miles of actual shore line, including indentations, have been surveyed. About 500 topographic, and 200 hydrographic sheets have been executed, and the soundings made amount to more than two millions and a quarter. Forty-four finished charts, and forty-one preliminary charts and sketches of important localities have been published. Numerous statistical data of this kind may be found in the annual report.

A feature of much interest and importance in the more recent history of the survey, is the addition of two sections on the Pacific coast to its field of active operations. It has not only pushed its parties into all the Atlantic and Gulf sections, but has already made a complete general reconnaissance of our entire Western Coast, and has published, or advanced to a state of forwardness, the maps embodying these results in a form most serviceable to navigation. Its parties have also made detailed surveys of all the principal harbors along this coast, as well as made excellent latitude and longitude determinations. Thus the navigator is already able to thread his way along that newly peopled-shore, with such aids as he still lacks on portions of our Eastern sea-margins. Special appropriations have been made to urge forward this important work, and it is surely a most sagacious policy to survey accurately and in detail those rapidly developed frontiers of our national domain. A systematic triangulation, and determination of points for a connected topography and hydrography, have already made a good beginning. Its consummation must be the work of from twelve to fifteen years.

The dangerous character of the Florida reef, extending for its entire length along a main highway of commerce, and producing a fearful loss of life and property, has led to successive specific appropriations for its more rapid survey. This work has progressed quite satisfactorily, especially when the difficulty of the locality and the extremely jagged coral sea-bottom are borne in mind. The study of coral characteristics is a highly interesting collateral, and Professor Agassiz, in the annual report of 1851, has given the results of an examination undertaken for the Coast Survey. Lieut. Rodgers' survey of Key West and its vicinity, gives a most interesting picture of a coral bottom, and vividly suggests the importance of submarine blasting to open a better channel into that important harbor. The Florida triangulation is one of peculiar difficulty, owing to the flat and overgrown character of the country, and the distance of the reef.

In conclusion, we state that the rate of progress of the survey points to its completion in about twelve years, though this time might be shortened, if desired, by increasing the appropriations. It is to be hoped that no vacillation of policy in respect to an enterprise so truly national and beneficial, is destined to check its progress, or interfere with its present systematic organization,—which, placing it under the Treasury Department, makes it an open field for the employment of both navy and army officers, as well as the civil assistants so indispensable to its organic completeness. It is now well, and the straightforward duty of our Government is to make liberal appropriations, and practise *laissez faire*.

SAXTON'S METALLIC DEEP-SEA THERMOMETER.

AMONG the many problems of terrestrial physics, which both invite and baffle complete investigation, one of the grandest and most attractive is that presented by Ocean temperatures. To determine the temperatures which characterize the varions depths, localities, and seasons throughout the vast expanse of the oceanic realm, is a work of immense labor, but one which cannot fail to give some results of eminent practical and theoretical value. Very little has yet been accomplished towards this almost boundless investigation, but that little has not been without fruit. In conducting the off-shore hydrography of the U. S. Coast Survey, the proximity of the Gulf Stream, and its important bearings on the chief highways of our commerce, have made it specially incumbent on the Coast Survey organization to develop the great physical features of this phenomenon with as much accuracy as possible. The exigency of the work of sounding along the shore has hitherto prevented the application of any great strength to the Gulf Stream problems, but several results of much interest, as to its form, position, movements, and temperatures, have been already reached in more or less detail.

The most casual inspection will show that the Gulf Stream is one of the great oceanic movements, or disturbances of equilibrium, caused by the varying temperatnres of its different tracts in the different seasons. Temperature is the prime moving element, which needs to be observed and reasoned upon with all possible care, to give that thorough and true explanation which every one desires, but no one possesses. How to observe the deep-sea temperatures which are thus disturbing the rest of the ocean—how to bring up, from a depth of several miles, a trustworthy reading of the heat which prevails in those unexplored recesses, is a qnestion which demands an answer before the Gulf Stream can be fully comprehended in its fundamental facts.

The proposed investigations are seriously obstructed by the enormous pressures in the regions to be explored, which derange all common contrivances. The ordinary glass thermometers were repeatedly tried in the Coast Survey soundings, but as uniformly broken. Attempts were made to protect them by strong metallic cases, which were also crushed in, as illustrated by an example now exhibited among the contributions of the Coast Survey at the Crystal Palace. Mr. Saxton, the eminently ingenious and successful head of the Instrument Department in the Coast Survey Office, then devised the deep-sea thermometer, which bears his name, and which has been used for several years with entire success. Some accidents, not faults of the instrnment, have had the effect to prevent such extensive observations as Mr. Bache had provided for, but it is to be hoped that each year will contribute to the number of our reliable observations with this elegant apparatus. One of these beautiful instruments is on exhibition in the Coast Survey collection at the Crystal Palace; and we proceed to state its principle and the arrangement of its parts.

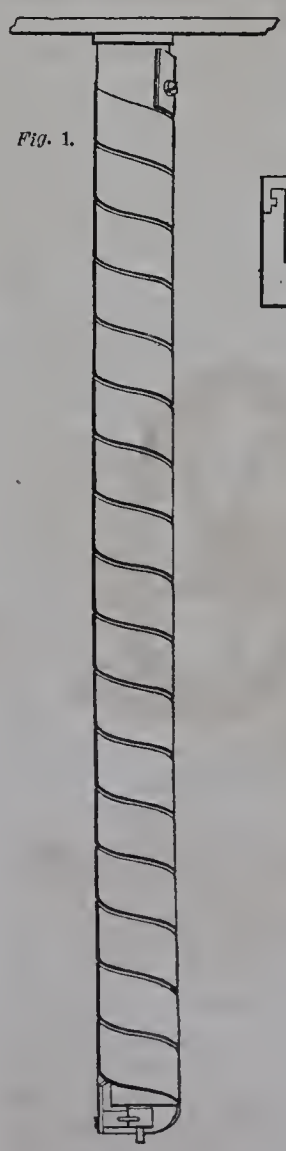


Fig. 1.

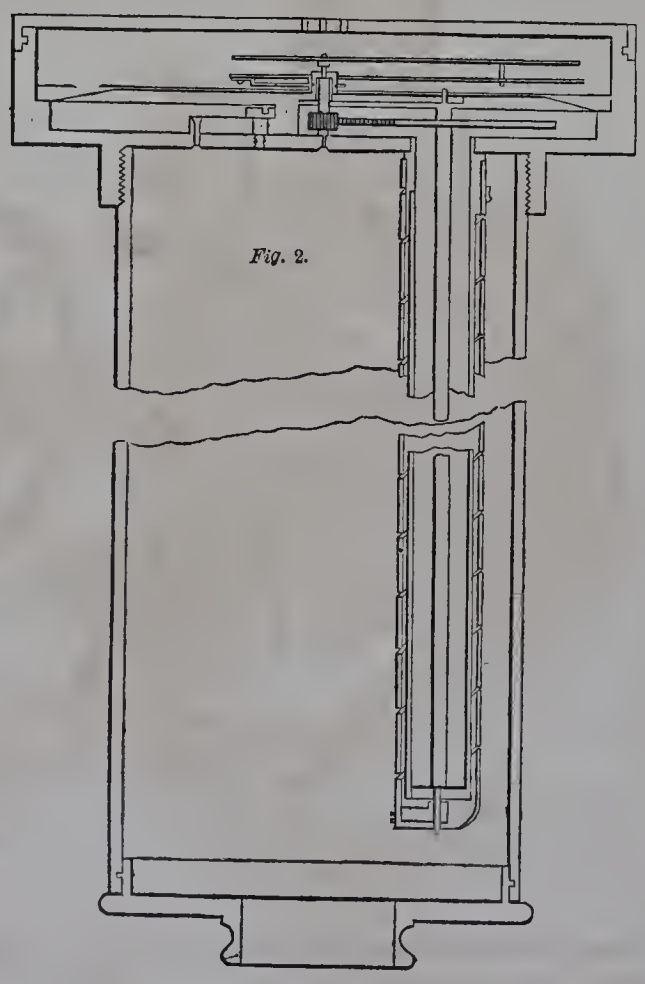


Fig. 2.

The main feature is a compound spiral or helical band or ribbon, composed of two similar plates firmly united along their surface of contact, the outer one being of silver, and the inner one of platinum. As the rates of expansion of these two metals are widely different, the variation of temperature to which the spiral is exposed, will produce a considerable movement of torsion, or rotation, at the bottom of the helix, the top being fixed. This principle is familiar in Breguet's torsion thermometer, and Mr. Saxton has only applied it to a novel case, with an improved arrangement at the upper extremity of the spiral, for magnifying and reading the indication furnished. The motion of rotation, given by a change of temperature, is very well fitted for reading, as by gearing it up, it gives a quite ample rotation to an index hand. Within the spiral is a hollow tube, to which at the top the spiral is screwed fast, as shown in Fig. 1. Within this tube is a small rod or axle, which is connected with the bottom of the spiral, and turns freely on a supporting pivot, so as to communicate the torsion rotation to a toothed silver wheel on its top, which is shown in Fig. 2: that part only being toothed which will be needed. A small pinion, which bears the index hand, takes up the motion, and is made to traverse the gradnated silver rim, and carry with it a stop hand, Fig. 3, which will indicate the maximnm or minimum temperatures passed in the descent, according to its arrangement. Surface temperatures are read off at once, and the sounding lines give the depths.

The whole of this arrangement is inclosed in a firm metal case, as shown in Fig. 4, which protects it from injury, and yet permits the water to pass freely around the spiral, causing it instantly to take the temperature of its locality.

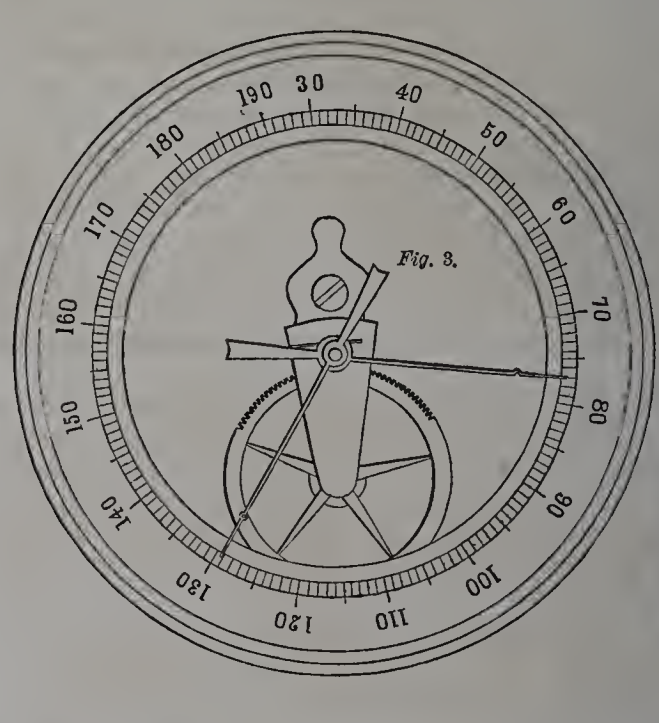


Fig. 3.

Fig. 4.

The top case is covered with a cap, pierced with small holes to permit the water to pass freely. The whole case is then monnted in a metal frame by means of two rings. The top ring turns on two side pivots, to permit the insertion of the case; but the lower ring is in halves, one of which is fixed, and the other opens out to receive the case, after which it closes, and is tightly clamped. An eye at the top receives the sonnding-line, and one at the bottom any requisite sinking weights. All the delicate parts of this thermometer, which could be corroded, are heavily electro-plated with gold, by Mr. Mathiot, in the Coast Survey Electrotype Laboratory, so that they are not liable to injury with fair treatment.

In using this instrument it is thrown from the side of the vessel at snccessive times, first observing the surface temperature, and then sinking it to a small depth, and again to one a little greater, and so on, till it can be decided that the stop hand indication belongs to the greatest depth attained. The passing of a point of maximum or minimum temperature, however, complicates the problem, and makes it a matter of critical judgment to connect the temperature and depth with accuracy. In the hands of good observers, it yields excellent results, and, though not all that could be desired, is still a most excellent instrument within the range of its capacities. Its cost, made in the limited numbers required in the operations of the Coast Snrvey, is about sixty dollars, though a demand for considerable numbers would much reduce this amount. We trust that this or some better instrument, if possible, will hereafter be employed with increased zeal in the study, not only of Gulf Stream temperatures, but of the ocean throughout its whole expanse, and even in our lakes and the interior seas of the whole world. Surface temperatures alone are quite insufficient to give correct results, for the solar radiation produces a great effect on the superficial layers, and we must penetrate to one or two hundred feet before we enter on the grand temperature scale. A minimum temperature is usually passed in descending, at that depth where the sun's effects may be assumed to terminate, and we then enter on an increasing scale of temperatures, which, according to one of Prof. Bache's discussions, give, with the co-ordinates of depth, a curve clearly and obviously the logarithmic curve. The connection between this result, and some of the grand results of that

theory of heat which treats it as an elastic fluid, is striking and eminently suggestive, though too recondite to be more than mentioned here. There is then a vast field of research, full of interest and promise, for whose exploration this thermometer is, we believe, the most reliable instrument, and we trust it will therefore be put into increasingly active requisition.

TYPE FOUNDING.

THE early printers in Germany made their letters in Gothic and semi-Gothic forms; and Caxton, in England, and Antoine Verard, in France, printed their works with a style of letter imitating the handwriting of that period. In Italy, under the influence of the beautiful manuscripts, more common there than elsewhere, and of the excellent taste of the early printers, the form of the letters was completely changed into the style which we use at the present day, under the name of Roman letters. In 1462, Louis XI., of France, sent Nicholas Jenson, an engraver in his service, to Mayence to learn the new art of printing. But Jenson, for political reasons, established himself in Venice, and engraved there the beautiful Roman characters, which Garamond afterwards took as models in engraving the types employed by the Elzevirs in their celebrated books. The Roman characters were also adopted by the Aldi and the Stephani, whose beautiful and finished works it is the glory of modern printers to imitate and rival. But little improvement has been made in the art of casting types since its invention, which goes back to the origin of printing itself. The types made by Baskerville and by Didot, are not more elegant and perfectly finished than the earlier masterpieces of the art which we have mentioned. The innumerable changes which have been introduced into the shapes and relative proportions of letters by the caprice of modern engravers, are retrograde changes, the fashion for a while, and then forgotten. The old letters of Garamond and Jenson have been again employed by Pickering and other eminent English publishers, and will probably always maintain their place with printers of taste.

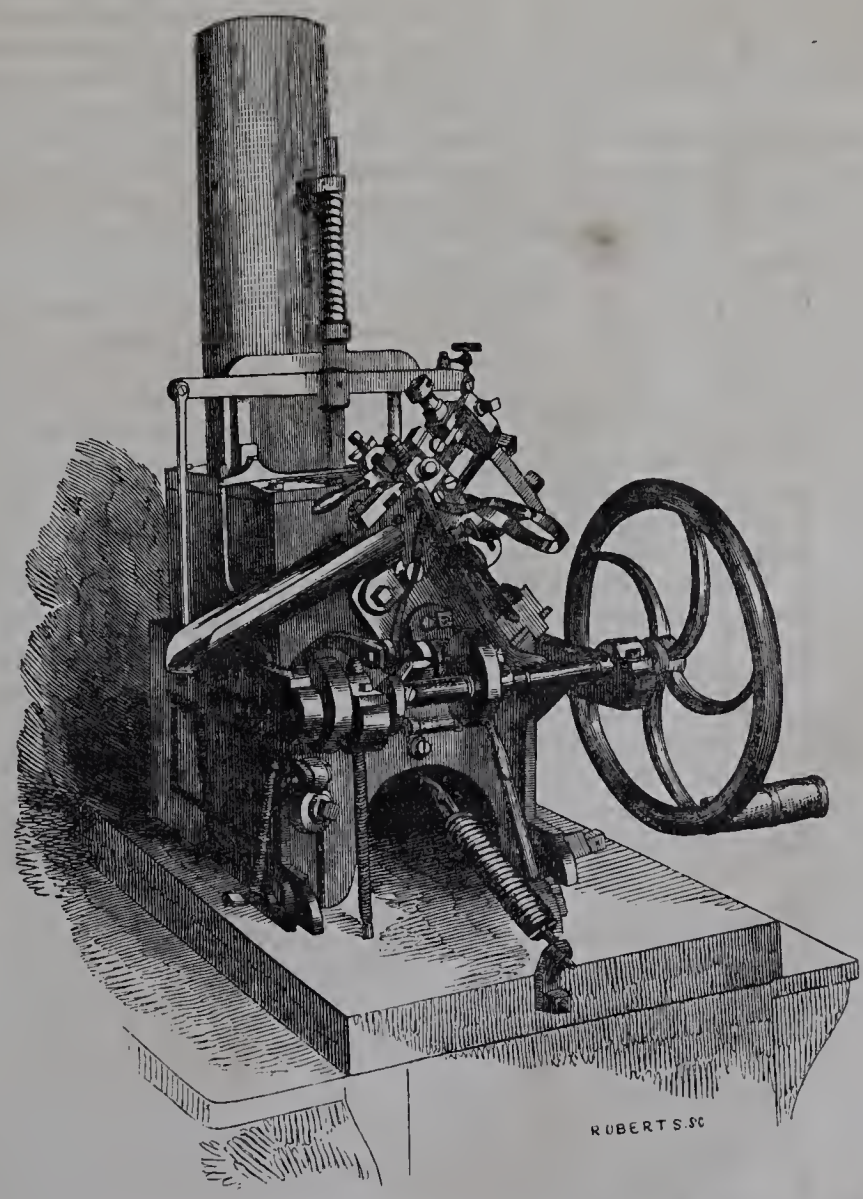
In the United States, types were first cast in 1735 by Christopher Sower, at Germantown. Unsuccessful attempts were made in 1768 to establish type-foundries, one in Boston, and another in Connecticut; but not long after the close of the War of Independence, the first regular type-foundry was set up in Philadelphia by Baine, who came there from Edinburgh. In 1790, Messrs. Binney & Ronaldson also commenced the business in Philadelphia, and met with great success from the growing number of newspaper and other job offices, which, in ten years, increased the amount of printing threefold, and caused a corresponding extension of the business of type-founding. These gentlemen are credited with the first improvement made in the art since its invention. It is a type-mould, which was introduced into Europe at the commencement of this century, and is known there as the American Mould. By this mould 6000 types are cast as easily as 4000 by the old process. The first extensive foundry in New-York was established in 1811, by Mr. White. He had before been a type-founder in Hartford, where he had invented and used a method of casting several letters together, but this device was dropped after his removal to New-York. Another type-foundry was erected in 1813 by Messrs. Bruce. The business has since been extended to keep pace with the increased number of newspapers and books published here, and each of the principal cities of the Northern and Western States now has one or more type-foundries. These give employment to about 800 persons, and produce daily between 4000 and 5000 pounds of type. They furnish nearly all the types used on this continent. Some of the finer book-work is still done, however, with English types, and the Oriental founts, and the beautiful Porsonian Greek type, employed at Mr. Trow's University Press in this city, are also imported.

The first and most important step in type-founding is to prepare the punches. They are pieces of soft steel, upon each of which the engraver cuts a single letter with all possible accuracy, and they are then carefully tempered. The face of the punch resembles the finished type. Its impression, made in soft copper, is called a matrix; it is the mould which forms the face of the type. The mould of the shank is made of two pieces of steel, which fit accurately to each other and the matrix, and are inclosed in wood for convenience of handling. The type metal is poured into a funnel-shaped orifice at the top, and by a peculiar movement of the caster's arm, is thrown into the cavities of the matrix. When the metal is set, the founder detaches the matrix from the face of the type, and the mould is then opened and the type removed. The overplus of metal which filled the funnel is next broken off, and the sides of the types are rubbed smooth, after which they are secured in frames, and have their ends cut smooth, and the lower one also ground. The process of *bearding*, which consists in bevelling the angle of the body below the letters, is performed at the same time. Types of the same fount are distinguished by one or more nicks upon the lower edge or end, which enables the compositor to set them correctly without looking at each. The composition of type metal is various. Lead forms about 75 per cent. of the alloy; it is united most commonly with antimony, but sometimes with copper, brass, tin, or bismuth. Within a few years, types have also been made by powerful steel punches from plates of cold copper; but we have not learned whether they have come into use.

The first successful machine for casting type was invented twenty-five years ago, by Mr. William M. Johnson. It did not come into general use, probably because the types manufactured by it were not as solid and durable as those made in hand-moulds. The latter continued to furnish the ordinary means of type-casting until six or eight years since, when the Type-Casting Machine, of which we give an engraving, was invented by David Bruce jr., of New-York. Its merits have been thoroughly tested by L. Johnson & Co., of Philadelphia, who exhibit the machine, and cast type with it in the Crystal Palace. These gentlemen have applied it in their extensive establishment to the manufacture of almost every variety of type, and have attained a degree of finish and accuracy entirely satisfactory. The peculiar merit of Bruce's Machine is, that it produces solid and substantial types with great rapidity—the limit being in the time required for the metal to solidify after entering the mould. The force with which the liquid metal is injected into the mould is so great, that the proportion of the defective letters is much smaller than in hand-casting. The fine lines of the matrix are brought out sharp and unbroken.

The space occupied by the machine is about 14 by 20 inches; including the wooden frame on which it rests, it is three feet high. A pot filled with type-metal occupies the back part, and a small furnace, fed with anthracite coal, is placed beneath it, or a gas-burner powerful enough to maintain the fluidity of the metal. A cylindrical tube or pump, stands vertically under the metal, and has a spout projecting from the front side of the pot. A piston rod, set in motion by a revolving crank, moves up and down in the cylinder, and at every revolution injects a small quantity of the metal into the mould, which, at the proper moment, comes closely up to the spout to receive it. After the metal has been received and hardened, which is done almost instantly, the mould recedes a few inches, its upper half rises, and the type is thrown out into a gutter leading to the receiving box. The type is then ready to be finished as we have already described. The power required for the various movements, is communicated by cams arranged along an axle, whose crank is turned by the right hand of the caster.

All, or nearly all, the types produced in American foundries are cast by machines; the only exceptions that we know of being large, ornamental type. Machines have been sent from the United States to Europe, and others have been invented there, but they have not been much used except in Germany. They are well known to type-founders in England, but have never been employed by them,



probably in deference to the prejudices of the workmen in their service. The use of machines for casting has contributed to reduce the price of type within a few years, but it is still an expensive article, not so much from the cost of the materials, as from the labor required to cast and finish it, each type having to pass through five separate operations; and they are also subject to rapid wear and deterioration, both when they are actually employed in printing and when stereotypes are cast from them.

Printers in the carly days of the Art, and indeed until recent times, cut and cast the type themselves, as well as executed all other operations connected with their profession, which are now divided among many distinct trades. This division of labor, and the excessive competition consequent upon it, have had the effect to destroy the original and personal characteristics which belonged to the work of ancient typographers.

The art of type-founding has now been successfully applied to every variety of langnage and alphabetic form. The reduction of the intricate and complex characters of Chinese to type is a triumph of the art. In the trnly magnificent display of the typographic art at the Exhibition of 1851, three methods of printing Chinese were exhibited, and all of them are now successfully employed in Europe and in Canton. The historical importance of saving from oblivion the languages and idioms of the human races, can be fully appreciated only by the philologist, and it would be foreign to our purpose to remark upon it here.

ASSIGNMENT OF SPACE.

THE following Official Report of the General Superintendent of the Crystal Palace, to the Board of Directors, shows the views and objects, which regulated the assignment of space in the Exhibition of the World's Industry:

Report on the assignment of space to home and foreign exhibitors, and to the several classes into which the Exhibition was distributed.

Three different methods of national assignment were considered.

One was geographical in its principle—the building being octagonal in its form, it was proposed to lay a plan of it upon a general map, and to place the nations as nearly as possible according to their relative geographical positions.

The second was to distribute the nations through the building by lot.

The third was to assign their situations arbitrarily, and with a special reference to the character of the exhibition of each nation.

The adoption of the latter method was rendered almost imperative by the situation of the Machine Arcade, and the necessity of placing England and America in juxtaposition with this part of the building.

By far the greater part of the machinery in motion will belong to this country. To the United States, therefore, is allotted the northeast quarter of the building which is nearest the seat of power, the boiler-house being on the opposite side of Forty-second street.

To Great Britain and Ireland is assigned the other division, (the southeast), adjoining the machine-room.

It fortunately so happens that this section with the galleries above, afford the amount of space demanded by the British portion of the Exhibition.

The two largest classes of exhibitors being thus disposed of under the rule of necessity, the distribution of remaining nations is less difficult. Even in this, however, circumstances supply a guide.

The whole of the northeastern section, with the corresponding galleries, are insufficient for the American part of the Exhibition—it is necessary to cross the north nave, and occupy some courts in the northwest section.

Again the contributions of France and the States of Germany are of themselves nearly enough to occupy one entire quarter of the building. The encroachment of the United States npon the northwest division, has not left them sufficient room there—it is most convenient therefore to divide between them the only remaining division—the southwest,—which, with the exception of two courts allowed to Belgium, they fill up entirely, their lighter productions occupying, as in other cases, the corresponding galleries.

The space now remaining to be assigned, is that part of the northwest division which is not filled up by the productions of this country.

This is capable of receiving the contributions of the other nations, and of the British Colonies. In this are placed Switzerland, Holland, Austria, Italy, the Canadas, Newfonndland, British Guiana, &c.

The form of the building might lead to the opinion that there was a greater choice of positions with reference to the sun, than is really the case. For those nations that snffer the disadvantage of a southern aspect on the walls bounding their space, have the advantage of north and west, or north and east lights on their nave fronts, and, on the other hand, the nations that are in the north divisions, encounter the sun on the line of their naves; consequently there is no great choice of positions on this account.

In the national assignment of space, two rules have in general been observed. One is to give to each nation the gallery above its floor space, another to give to each nation a front on some one of the naves.

The first of these rules could not be invariably followed. Switzerland, for example, required no floor but only gallery space, while Holland, Austria, and the British Colonies required only floor space. The particular cases are decided by the nature of the property exhibited.

After the general assignment of space to the nations comes the subdivision among the classes.

The machinery in the case of Great Britain and America is placed, of course, either in or adjoining the machine-room.

The sculpture and finer products of artistic skill, the paintings excluded (for which there is a distinct gallery), are exhibited with the best effect in or near the naves. It is my purpose, therefore, in the local distribution of the classes, to proceed in each division ontward towards the naves, from the productions of nature to the works of art, and from machinery to its results.

This purpose has governed me in the arrangement of the classes in the American department of the Exhibition. The same general views have been applied, as far as is convenient or practicable, in the other national departments.

I have adopted the general classification of the materials of the Exhibition, made at the Great Industrial Exhibition of London, with slight exceptions, one of which is the subdivision of class ten, and the creation of a new class of musical instruments, which is numbered 30.

The analysis and further separation of the classes, I leave to the juries.

Very respectfully, your obt. serv't.

S. F. DU PONT, General Superintendent.

We add to the Official Report of the Superintendent the list of Classes under which the articles have been arranged.

LIST OF CLASSES INTO WHICH ARTICLES ARE DIVIDED.

Class 1. Minerals, Mining and Metallurgy, and Geological and Mining Plans and Sections.

2. Chemical and Pharmaceutical Products and Processes.

3. Substances nsed as Food.

4. Vegetable and Animal Substances employed in Manufactures.

5. Machines for direct use, including Steam, Hydraulic and Pneumatic Engines, and Railway and other Carriages.

6. Machinery and Tools for Manufacturing purposes.

7. Civil Engineering, Architectural and Building Contrivances.

8. Naval Architecture, Military Engineering, Ordnance, Armor, and Accoutrements.

9. Agricultural, Horticultural and Dairy Implements and Machines.

10. 10. Philosophical Instruments, and Products resulting from their use, *e. g.* Daguerreotypes, &c.,) Maps and Charts.
    10A. Horology.
    10B. Surgical Instruments and appliances.

11. Manufactures of Cotton.

12. " " Wool.

13. " " Silk.

14. " " Flax and Hemp.

15. Mixed Fabrics, Shawls, Vestings, &c.

16. Leather, Furs, and Hair, and their Manufactures.

17. Paper and Stationery, Types, Printing, and Bookbinding.

18. Dyed and Printed Fabrics, shown as such.

19. Tapestry, including Carpets and Floor Cloths, Lace, Embroidery. Trimmings, and Fancy Needlework.

20. Wearing Apparel.

21. Cutlery and Edge Tools.

22. Iron, Brass, Pewter, and General Hardware, including Lamps, Chandeliers, and Kitchen Furniture.

23. Work in Precious Metals, and their Imitations, Jewelry, and other Personal Ornaments, Bronzes, and articles of Vertu generally.

24. Glass Manufactures.

25. Porcelain and other Ceramic Manufactures.

26. Decorative Furniture and Upholstery, including Papier-Maché, Paper Hangings, and Japanned Goods.

27. Manufactures in Marble, Slate and other Ornamental Stones, Cement, &c., for Construction and Decoration.

28. Manufactnres from Animal and Vegetable Substances, not woven or felted or otherwise specified.

29. Miscellaneous Manufactures and Small Wares, Perfumery, Confectionery, Toys, Taxidermy, &c.

30. Musical Instruments.

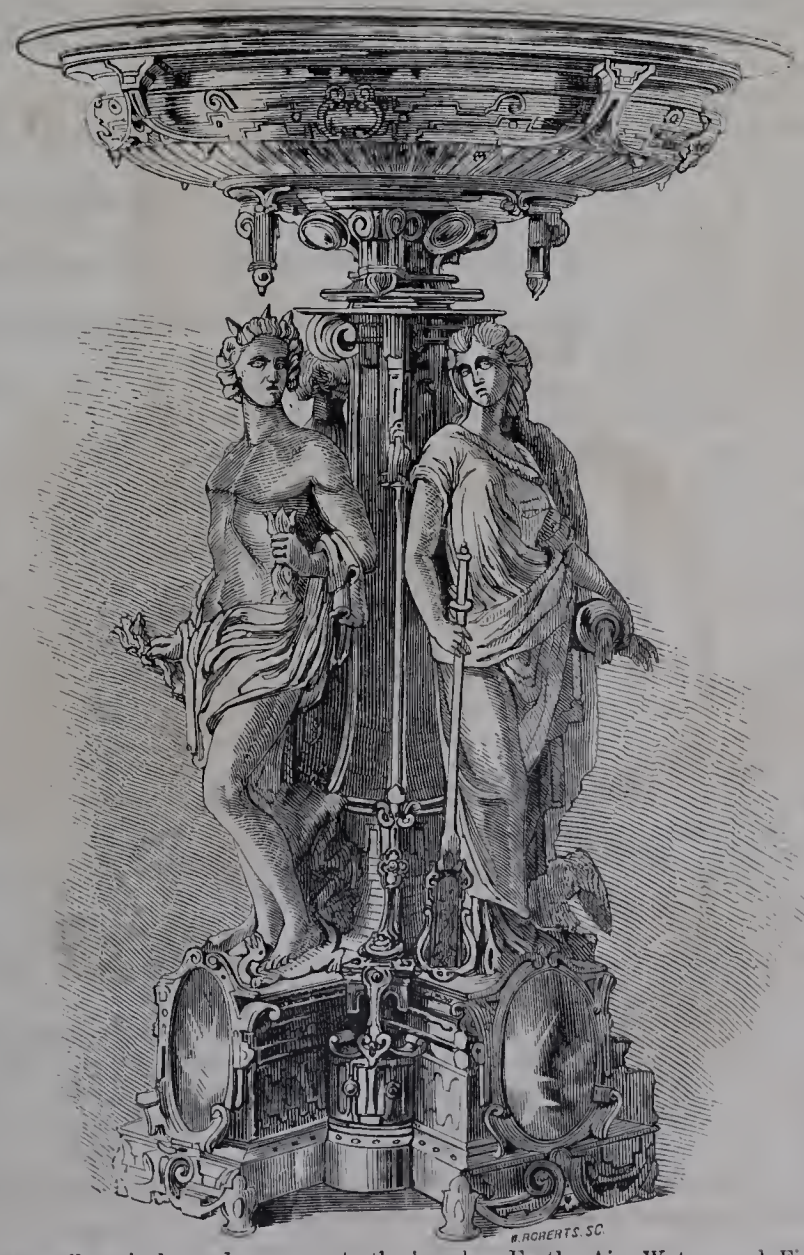
31. Fine Arts, Sculpture, Paintings, Engravings, &c.

We fill another page with those exquisite examples of art-manufacture, which illustrate and sustain the claim of France to artistic prenence. The BRONZE VASE, at the top of the page, and the adjoining CHANDELIER, are contributions of LEROLLE, FRERES. The globe which forms the central part of the latter, is covered with a

rich blue enamel, set with golden stars, and supports a female figure, which, as well as the branches of the chandelier, are richly gilt.

The piece beneath, representing a WILD BOAR, attacked by dogs, is one of the bronzes exhibited by AUGUSTE WEYGANT, of Paris.

The large CENTRE PIECE is exhibited by Messrs. TIFFANY YOUNG & ELLIS, of New-York and Paris. It is executed by them, both in silver and bronze, the one in the Exhibition being silver. The supporting figures



are allegorical, and represent the elements of ancient physical philosophy, Earth, Air, Water, and Fire; the two latter are the ones in view.

Italy maintains her reputation as the home of the Fine Arts, by her numerous contributions of statues and paintings to the Exhibition. The sides of the West and North Naves, and the Italian quarter are filled with a profusion of these beautiful objects. On this page we engrave ATALA and CHACTAS, the Indian heroine and warrior of

Chateaubriand, the work of INNOCENZO FRACCAROLI, a sculptor of Milan.

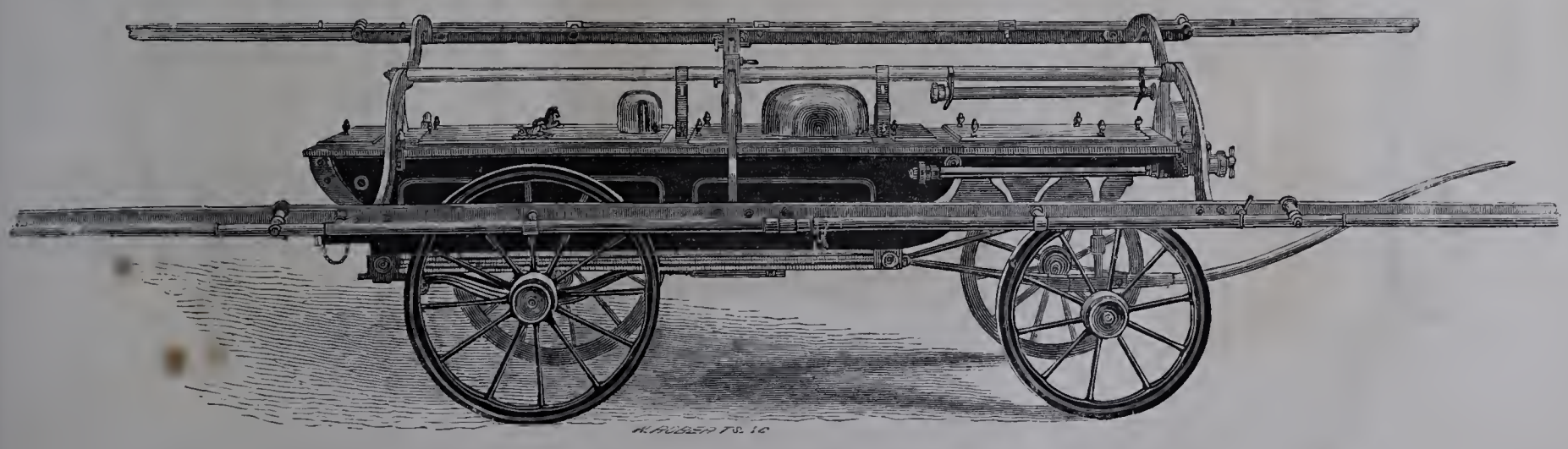
The winged boy, called the GENIUS OF SPRING, is the work of PELLICEIA director of the Fine Arts Academy, at Carrare.

The MARBLE MANTLE, with which we conclude this page, is exhibited by JOHN KENNEDY, of New-York. the

designer and manufacturer. It is sculptured in the renaissance style, with friezes of foliage and grotesque heads, and is supported by figures of nymphs.

From the examples of decorative furniture which are exhibited in the French Department, we have selected and engraved upon this page a large and beautiful BUFFET, contributed by RINGUET, LEPRINCE & Co., of Paris and New-York. This article, we are informed, was manufactured in this city, although it is placed among the

other contributions of the house which come from Paris. It is elaborately carved in black walnut, and further ornamented with decorative paintings.



The FIRE ENGINE of which we give an illustration, was made by WILLIAM JEFFERS, Pawtucket, R. I. It appears to be of excellent workmanship.

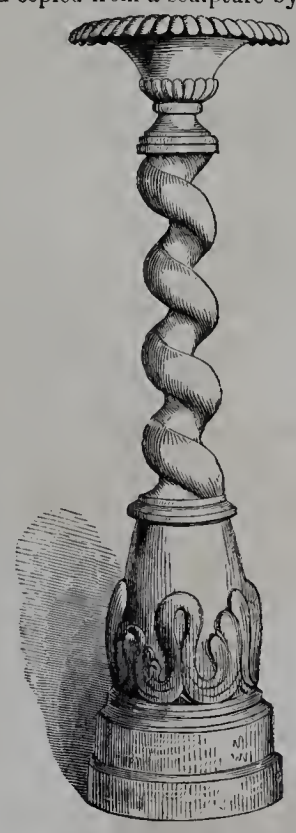
There are no more beautiful and interesting objects in the Exhibition than the bronzes of the French Department. The French have excelled all others in this exquisite branch of art-manufacture, whether the excellence of the workmanship, or the beauty of the designs is considered. We commence our illustrations of the bronzes

The EMIGRANT, a plaster model of life size, is exhibited by S. LAWLOR, London.

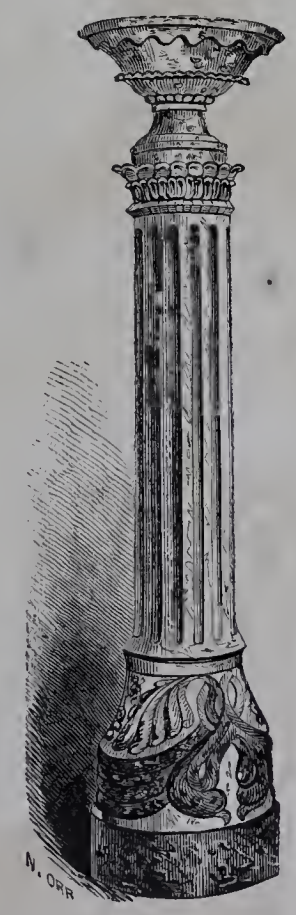
with three subjects from the contributions of LEROLLE, FRERES, of Paris. The elaborate CLOCK in the centre represents the Conversion of a Saracen. It is accompanied by a Candelabrum on each side, one of which is supported by the figure of a Moor, and the other by a Crusader. Both of these bronzes are richly gilt and silvered.

We engrave two elegant PARLOR CHAIRS, which form part of the contributions of BALNY, Jr., of Paris. One is enamelled in white with gold decorations, and upholstered with white and red damask, in the style of Louis Quatorze; the other is of French black walnut.

The large CANDELABRUM upon this page is another of the exquisitely beautiful bronzes contributed by LEROLLE FRERES. It is a rich example of the style of Louis XV. From a base of marble or bronze, rises the branching and foliated stem of the lights, and is supported in front by a loosely-robed Bacchante, crowned with a wreath of ivy and grapes, and copied from a sculpture by Canova.

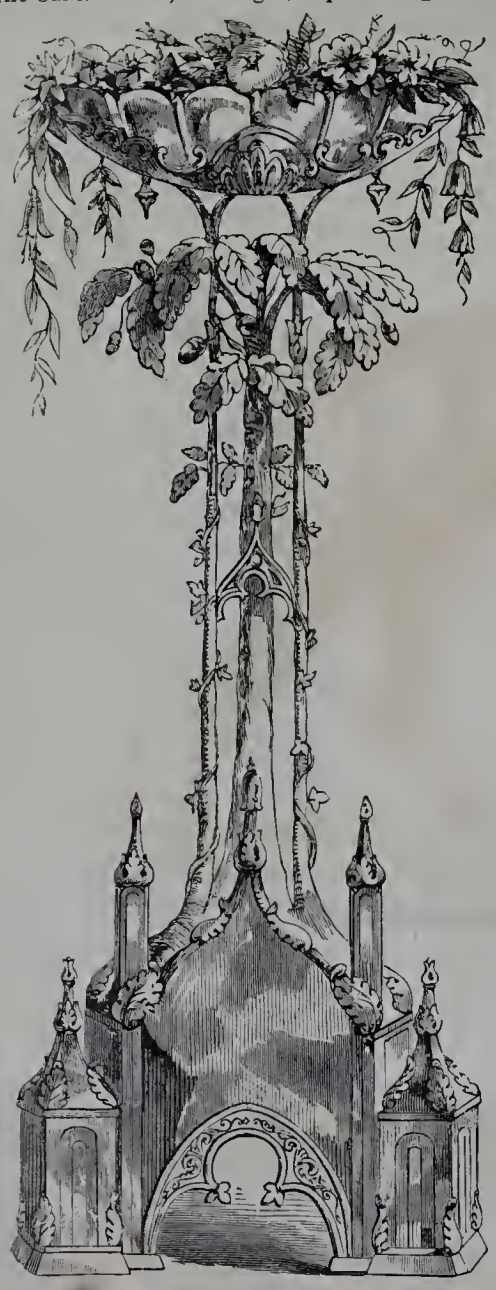


In the Austrian Department the visitor's attention is attracted by a curious collection of variegated marbles, and the fossil ammonites of which it is mainly composed. The two CANDELABRA here given are cut from this marble. They are exhibited by J. G. RAMSEUR, of Hallstadt, Upper Austria.



The adjoining engraving represents the REPEATING RIFLE, invented by Col. P. W. PORTER, of Tennessee. It is an excellent example of the beauty and good workmanship of American firearms. The engraving also shows to a considerable extent, the mechanical peculiarities which render this so efficient and formidable a weapon. A full description will be given in another part of the RECORD.

The CENTRE PIECE, silver gilt, representing the stems



and foliage of the oak, is emblematic of Europe. This

and the adjoining GROUP of silver ware—a breakfast or tea service—are among the contributions of Mr. ANGELL, of London.

ANDREA BONI, of Milan. It is in terra cotta, and is a creditable example of that art.

The characteristic work which fills the remainder of the page,

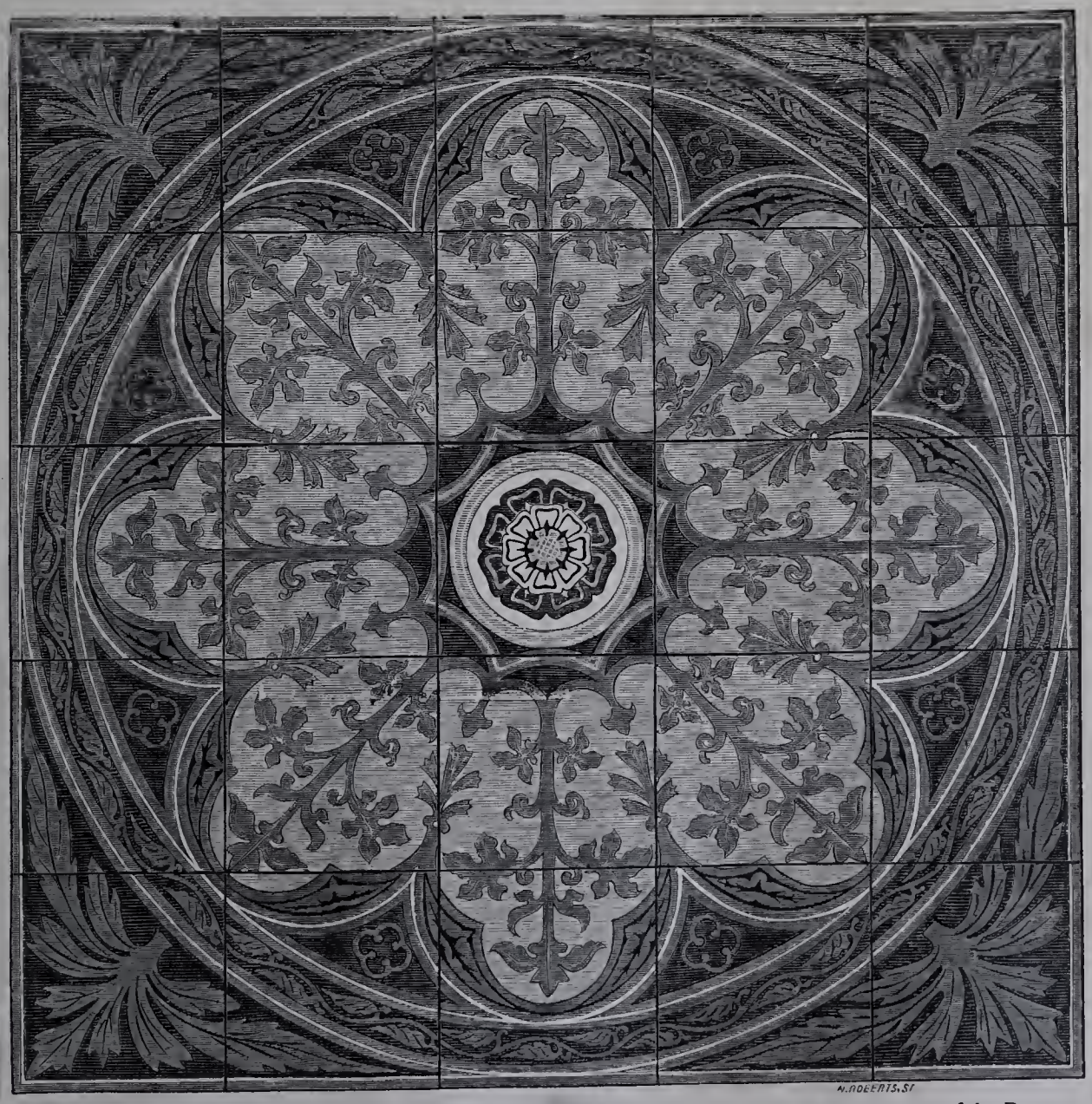
The STATUE of a female, which we engrave on this page, has had no name imposed upon it by the sculptor, hardly needs to be named. The CAGE OF CUPIDS explains itself. It is executed in marble, and exhibited by GAETANO MOTELLI, of Milan.

The statue representing Erminia writing the name of her lover, Tancredi, is the work of Signor Pelliclia.

The Terra Cotta Vase belongs with the similar American objects given on a previous page.

The spirited Bronze Dog, called the Sentinel, represents a cross between the St. Bernard and the English mastiff. He has just broken his chain, and while enjoying his new liberty, he stops, arrested by the familiar sound of his master's voice. The half-open mouth, and protruding tongue, indicate his quick panting; his ears are thrown forward, and his eyes are directed towards the point from which the sound came. The expression of the face shows the good nature of the noble animal, as if he only waited a second call to return. The Sentinel is a likeness of a dog formerly owned by T. F. Hoppin, Esq., of Providence, by whom it was modelled, and is exhibited.

We engrave one of the Encaustic Tiles, for whose manufacture Messrs. Minton & Co. have become famous. It is a mediæval art, invented probably to imitate Roman mosaic pavements. Messrs. Minton enjoy the honor of having restored it, following the ancient uses, forms, and patterns, but inventing new mechanical means to produce them In a future part of the Record we shall describe them at length with colored illustrations.



From the profusion of articles in terra cotta manufactured and exhibited by ANDREA BONI & Co., of Milan,

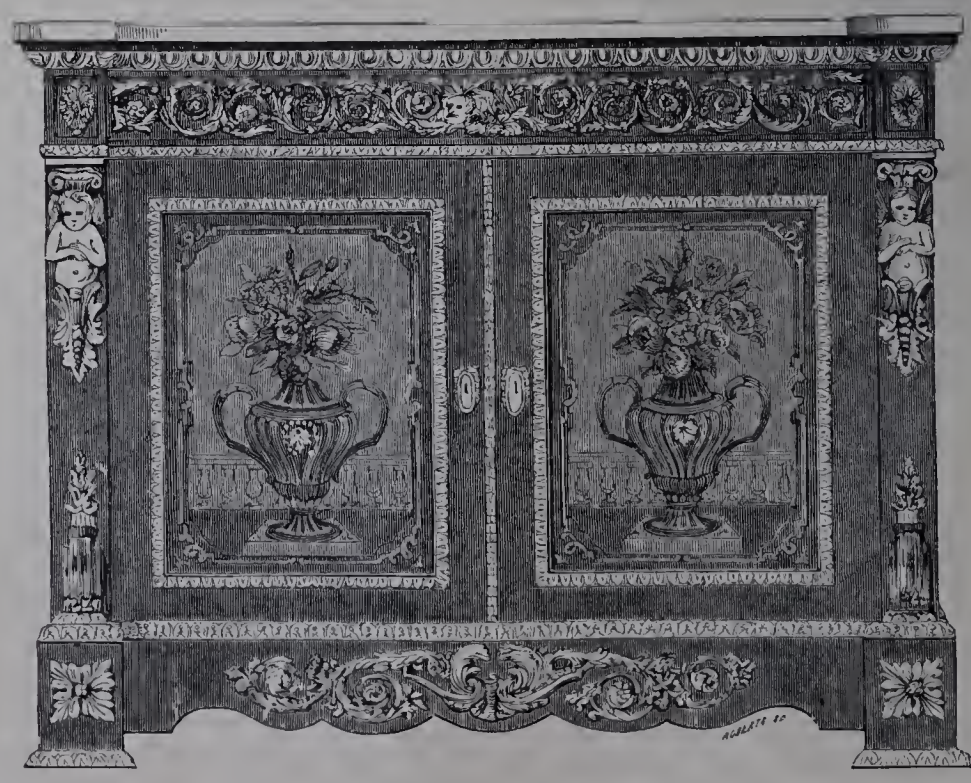
we engrave, at the top of the page, an elaborate PITCHER, and a GROUP of statuettes, the figures being chiefly Italian.

Messrs. T. & R. BOOTE, Burslem, Staffordshire, exhibit a variety of articles in parian and porcelain of great ex-

cellence and beauty. We select a VASE of blue parian, and a graceful PITCHER, or JUG, as our English friends call it, both decorated with wreaths of flowers, &c., in white parian. These ornaments, delicate and beautiful as they are in themselves, from their high relief, and the under cutting to which they have been subjected, are unsuited

to adorn the exterior of fictile wares, which admit no ornaments that rise sensibly above their surface, and break their outlines. This applies equally to the ornaments upon the VASE in the adjoining GROUP, exhibited by T. J. & J. MAYER, of Dale Hall Pottery, Staffordshire.

A CABINET of ebony, with inlaid panels, is contributed by RINGUET, LEPRINCE & Co., of New- | York. The brass gilt ornaments, which are abundantly



displayed upon this piece, are neither beautiful in | themselves, nor do they produce a pleasing effect.

VOLTA BEFORE NAPOLEON AT THE FRENCH INSTITUTE.

THE ELECTROTYPE PROCESS.

WHEN Galvani was convulsing frogs with his rude primitive battery, or when Volta was presenting to the French Academy an account of his more advanced arrangements and results, there was but slender promise of such magnificent fruits as are now seen in the electrotype process, and in the magnetic telegraph. The twilight dawn of great discoveries, like the remote sources of mighty rivers, foreshadows to common perceptions nothing of the future greatness which their full career is to embody. That subtle agency, which Volta expounded, in imperfect phrase, before the French Academy, is now known to be as wide as creation in its workings, and as intangible as the spirit of man in its substance. Already have electric currents, in their widely-varied functions, been found to pervade nearly all of material nature, and the history of electrical science has grown voluminous and absorbing beyond all precedent; though we are still constrained to believe ourselves only on the verge of this expanding realm of fact. Our present business is with this current as a worker, in a particular limited field, where it serves as a delicate fingered artist in metals, or wears the guise of a transcendental Tubal-Cain: for such is the function of dynamic electricity in its electrotype uses. The discussion of electric metallurgy, in its wide and rapidly enlarging extent, would so much exceed our limits, that we must rest content with treating the electrotype proper, or the process of reproducing metal plates by molecular deposition, through the regulated action of galvanic currents.

The electrotype renewal of engraved plates with perfect correctness of detail, has now become a process of as entire certainty as any of the coarser forms of casting, for all sizes and descriptions of work engraved on copper. The finest touches of the graver can be indefinitely multiplied without any loss of delicacy, and in a very short time. No mechanical impediment now prevents the unlimited reproduction of copies from the largest and finest copper-plates ever engraved, and this at a cost, which compared with the usual prices of such prints, is absolutely trifling. One cannot but long to see this process applied to those elaborate plates, the prints from which have been sold for prices up to fifty dollars, or more, under the conviction that only a few impressions could be obtained without re-engraving, thus making the cost of a single impression about equal to the expense of making an electrotype copy of the original copper-plate. The time apparently is near at hand, when fine engravings of this description will receive so wide a diffusion as to make the original outlay for engraving a mere trifle, when distributed among the great number of copies which a low price will cause to be sold. Some publisher who is an art philanthropist, and sagacious withal, will ere long extend the principle of cheap publication into this higher department of art; thus making a portfolio of engravings by the best masters a luxury within the means of thousands, who are now excluded from their purchase by the alarming prices of good line engravings. The finest works of art can be electrotyped with the same ease as the coarsest map plate; nor is the cost of printing and paper very much increased by the fine quality of the subject, or by its delicacy of treatment.

The electrotype process was made a practical fact by Jacobi and Spencer, in 1838, though an instance of electro-metallic deposit is recorded so long ago as 1805, which however lay quite fruitless. Its rapid strides in improvement up to the present time, have been due to the united labors of many intelligent practitioners of its several forms of application. Ohm's law, and Smee's laws of current actions, have given fundamental principles for reasoning and experiment, which have guided investigators in their operations, directly to positive and excellent results.

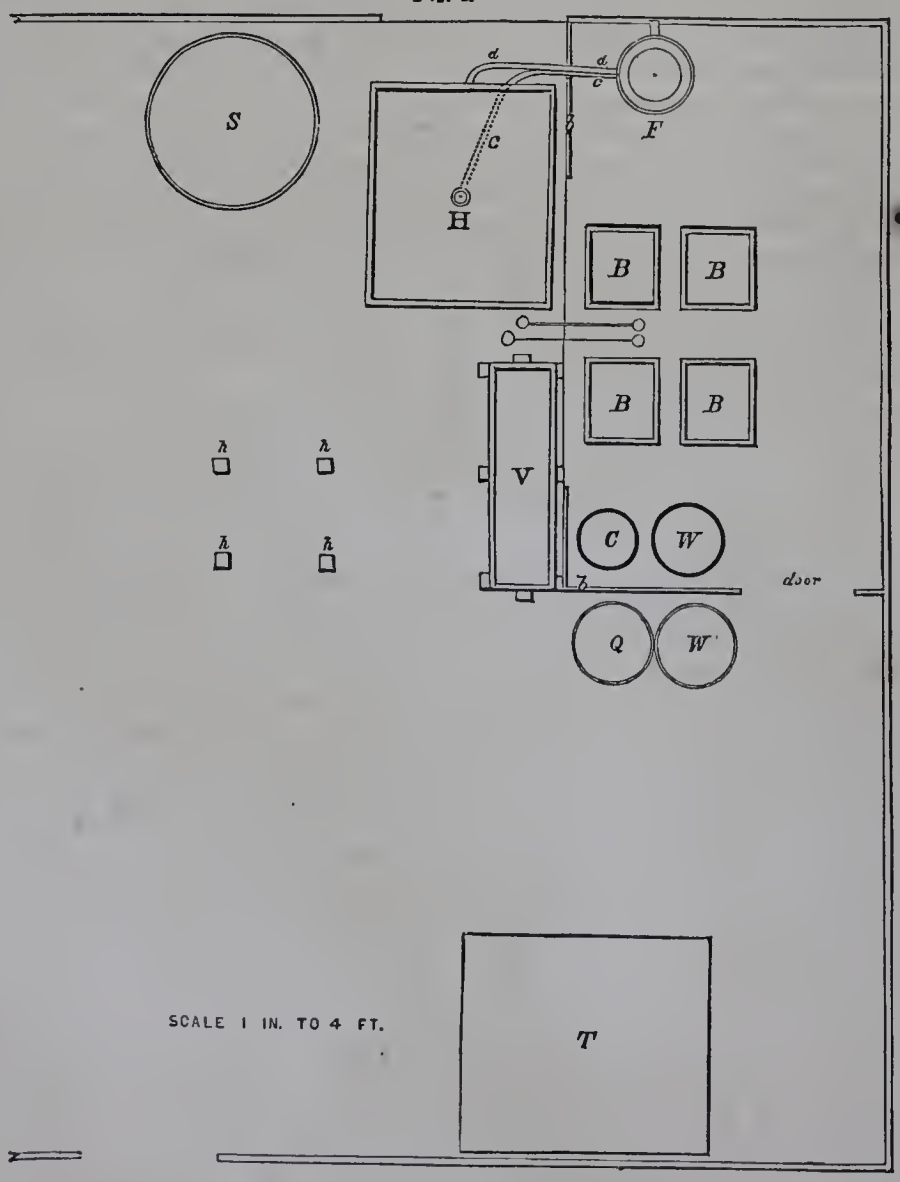
The chief articles of interest, in connection with electro-metallurgy, now on exhibition in the Crystal Palace, are the large map plates of the United States Coast Survey, made in the office of the Survey at Washington; the map plates of the British Ordnance Survey, made in the Ordnance Map Department at Southampton; and the several articles in the English Department, contributed by Elkington, including various castings of reliefs, busts, ornamental vases, &c., and specimens of electroplating.

We will now present in brief the mode of copying engraved plates in the Coast Survey Office by Mr. G. Mathiot, who has there devised many of the processes and appliances so successfully employed. Visitors will observe in the Coast Survey space, under the great North window, three plates, 42 by 38 inches in size, containing work of the finest quality. These are respectively an original plate, an alto or relief-lined plate, and a basso, or duplicate, so like the original as not to be easily distinguished, except by examining the back. This original, on being completed by the engravers, was carefully cleaned, and its surface silvered. It was then washed with an alcoholic solution of iodine, and exposed to the action of light; this process, one of Mr. Mathiot's invention, is beyond question far the best means in use for preventing a final adhesion of the deposit to the matrix plate. The plate thus prepared, was suspended vertically in a vat, containing a solution of sulphate of copper, and a raw copper-plate, of rather larger size, suspended parallel to it. These plates were then made to serve as electrodes, by being connected with a powerful battery. The copper in the solution of sulphate, which adjoins the engraved face, was thus deposited by decomposition, being thrown down as a pure copper layer on the face, while the free acid acted on the raw copper-plate, and thus sustained the strength of the solution; the whole action amounting to a transfer, or carrying by water, of the copper from the rough plate to the engraved surface. When the deposition had progressed far enough to form a good surface-layer, the plate was shifted into a horizontal vat of the same solution, and the raw copper-plate supported on a frame just above it. A specially contrived furnace sustains in this solution a heat of about 180 degrees, which greatly facilitates deposition. The current was again brought to act, and maintained in steady operation until the deposit attained the thickness requisite for safe handling. The plate and deposit were then withdrawn from the solution, filed around their common edge, and the two were then separated or split apart through the iodine layer which was introduced on the original face, forming probably an iodine atmospheric film. The deposited plate is the alto, which exhibits, in relief and direct, all the engraved reversed lines of the original. This alto was then made to serve in turn as a matrix, on which a new copper-plate, one-eighth of an inch thick, was deposited in precisely the same manner as in forming the alto. This plate is an exact duplicate of the original, and is called a basso, or an electrotype copy. It requires only a little smoothing on the back, and a removal of any accidental specks or imperfections, to be ready for the printer. The time occupied in the reproduction of a plate, containing ten square feet, can be brought within a week for forming both alto and basso, though economy of working usually makes it preferable to take somewhat more than this minimum time. A careful regulation of the current under Smee's laws is of great importance as an indispensable means of securing the requisite metallic properties in the deposit. Planished copper-plates are quite inferior to good electrotypes for printing, as the pure metallic copper resulting from electro-deposition is free from that porosity which produces cloudiness of impression. The work of inking and wiping an electrotype is considerably less than for a planished plate, and the wear for each impression is consequently less. The first electrotype copy of the largest plate exhibited, printed about two thousand impressions, without showing wear, though the work is remarkably light and fine, so that the original would probably have failed in less than one thousand printings. The cost of producing these large plates may be judged from the rate of deposit, which is sometimes as high as 3 lbs. per square foot, in twenty-four hours. The consumption of materials admits of accurate estimate, but the cost of work, apparatus, &c., varies

much with the kind and quantity of work to be done; though a dollar per pound would probably prove a remunerating price in regular work, free from piecing or inserting. Smeo estimates at a sovereign per pound, but this rate is certainly much above what the methods of Mr. Mathiot would require. This process of reproduction is made to serve as a means of inserting views, uniting separately engraved plates, so as to shorten the time of engraving, and also to facilitate erasures, by scraping off from an alto the relief lines to be erased, and then obtaining a basso, blank in those parts. Thus the scarring and beating up from the back, which make ordinary copper-plate erasing so troublesome, are quite avoided.

A critical examination of the Coast Survey plates, will show that they are as perfect as copper-plates seem capable of being made. A comparison of these with the Southampton plates, will show a marked superiority in their evenness of deposition, and in the smoothness of their backs. The Ordnance Survey plates required to be laboriously filed all over their backs, while the inequalities filed from the backs of the Coast Survey plates were comparatively insignificant, though these plates quite exceed the English in size and thickness. Indeed the results indicate a decidedly better management of the currents by Mr. Mathiot, than is displayed in any other electrotype work exhibited. In Elkington's electro-castings there is a degree of interior roughness, which, making all due allowance for the irregular forms of his subjects, indicates a much less perfect control of the deposit than is exhibited in the Coast Survey plates. So far as we have the means of knowing, these plates exhibit the electrotype art in its highest attained perfection. As the French Government is about borrowing the Southampton arrangements for a laboratory, connected with their *Dépôt de la guerre*, under the impression of its superiority to all European establishments of this nature, we may conclude that the Coast Survey Laboratory, excelling that of Southampton, as it clearly does, both in the facility and the results of its operations, stands absolutely at the head of electrotype practice in reproducing plates. The use of iodine to prevent adhesion, the heating of the electrolytic solution by a constant furnace, the electro-deposited silver plates, used in the batteries, and other minor improvements, wrought out by Mr. Mathiot, are quite sufficient reasons for this superiority. We quote from his Report (Am. Journal of Science, vol. xv., 2d series, 1853, and C. Survey Report for 1851, Appendix 55), the following description of the C. S. Laboratory, apparatus and manipulations:—

Fig. 1.



"Laboratory Apparatus.—Figure 1 is a plan of the Coast Survey Electrotype Laboratory. The glazed partition, *b*, *b*, *b*, *b*, with a door, *d*, separates the battery room from the general laboratory, and permits an easy inspection of the batteries, without exposure to their fumes. The laboratory floor is about six feet above the ground, and slopes inward from the sides towards the scuttle holes, *h*, *h h*, *h*, arranged for discharging the waste liquids spilled upon the floor. To obviate the deleterious effects of working on a floor saturated with chemical agents, when any solutions are spilled, the floor is well flooded and brushed, the water passing off through the scuttle holes. There are four battery cells, placed as indicated, B, B, B, B. A rectangular India-rubber bag, supported by a deep wooden box, contains the battory solutions. Each cell can contain nine silver and eight zinc plates. A metallic connection unites all the zinc plates of a cell, and another one all the silver plates. Each cell can be used as an independent battery, or two, three, or four cells can bo connected in consecutive or simultaneous order, or all combined into two pairs of two in consecutive or simultaneous order, or into one group of three and one of one. The position of the vertical decomposing vat is shown at V, and that of the horizontal vat at H. S is a large tub for washing plates. The tub C contains the solution of chlorid of iron. Q is the quicksilver tub, and W, W, are fresh water tubs. F is the furnace, and *d*, *d*, *c*, *c*, are heating tubes connecting with the vat H. T is a flat iron table.

Fig. 2.

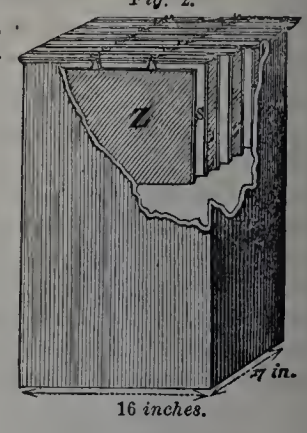


Fig. 2 exhibits a cell and its included plates, with their mode of suspension.

Fig. 3 represents the suspending frame of wood and the attached plate, P, prepared for immersion in the vertical vat.

Fig. 4 shows the vertical vat and the plates suspended in it.

Fig. 3.

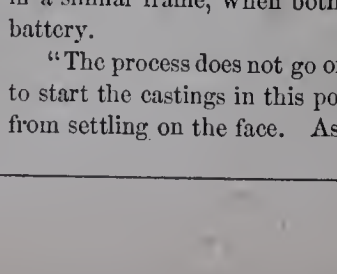


Fig. 4.

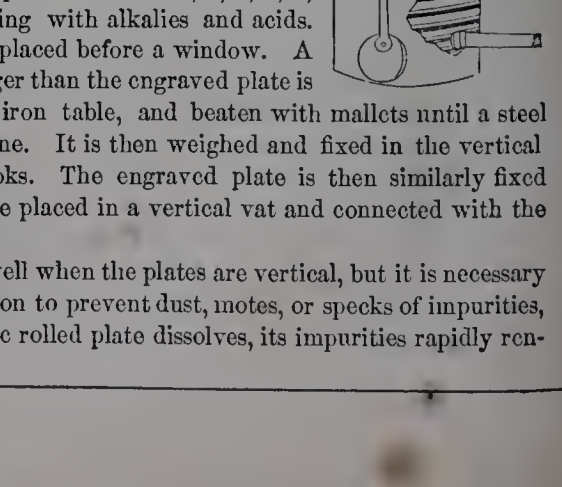


Fig. 5 represents the adjustable plate-supporting frame used in the horizontal vat.

F. 5.

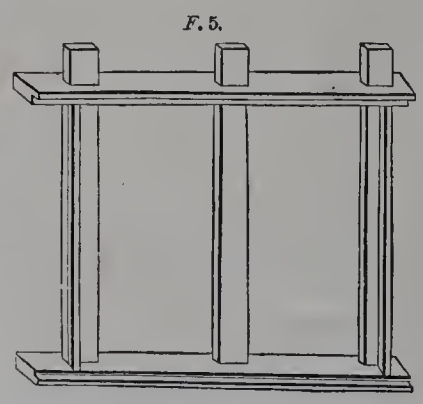
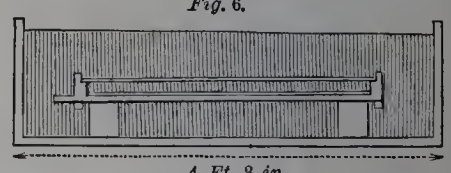


Fig. 6 exhibits the interior arrangement of the horizontal vat, a blank plate and an engraved original being in position; also the connecting copper rods leading to the battery.

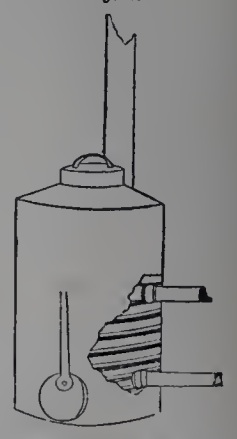
Fig. 7 represents the heating furnace. The door for admitting air is shown at

Fig. 6.



a, and is so connected with an adjusting compound bar of iron and zinc that by an adjusting screw it can be arranged to regulate the draught, opening or closing the door, thus maintaining a uniform heat in the solution. After getting the fire started, this door is set so as to close when the solution reaches a heat of 180°. In principle this furnace is similar to a bath-heater. A tubular helix of lead is coiled within it like the worm of a still, and the terminating branches *c* and *d* lead to the horizontal vat, the branch *c* uniting the top of the vat just below the liquid surface with the top of the coil, and *d* at the bottom of the vat with the bottom of the coil. Hence follows a circulation of the solution from the furnace at top and into it at bottom.

Fig. 7.



"Manipulation.—When a plate is to be electrotyped, it is placed on trestles above the open scuttle holes, *h*, *h*, *h*, *h*, and thoroughly cleaned by washing with alkalies and acids. It is then silvered, iodized, and placed before a window. A plate of rolled copper an inch larger than the engraved plate is then selected, placed on the flat iron table, and beaten with mallets until a steel straight edge shows it to be plane. It is then weighed and fixed in the vertical plate frame by two copper hooks. The engraved plate is then similarly fixed in a similar frame, when both are placed in a vertical vat and connected with the battery.

"The process does not go on well when the plates are vertical, but it is necessary to start the castings in this position to prevent dust, motes, or specks of impurities, from settling on the face. As the rolled plate dissolves, its impurities rapidly ren-

der the solution muddy, and endanger the face of the forming plate. For common electrotypes dust or mote specks are not detrimental; but the Coast Survey copper-plates being not inferior in fineness of lines to fine steel plates, the effect of impurities settling on the face of their copies is to give the impressions a clouded appearance. On first immersing the plate, the solution should, therefore, be perfectly clean. Formerly, after each use of the vertical vat, it was emptied and washed out. When the solution had deposited its sediment it was drawn off and strained through very fine cotton. This whole operation was extremely disagreeable, and consumed a whole day of one man.

"By a simple expedient I have saved the necessity of cleaning the vat oftener than once a month. To guard the new plate from specks and impurities, a bag of fine cotton is drawn over a slight wooden frame, which keeps it distended. An hour or more before the solution is wanted, the bag, with its included frame, is placed on top of the solution and loaded with the copper bars used to support the plate frames. The weight causes the bag to sink gradually, filtering the contained solution as it goes down; the impurities cannot wholly choke the meshes of the cloth, as a fresh portion is constantly brought into action during the sinking. I thus filter the solution without taking it from the vat or disturbing the sediment, saving much labor, time, and annoyance.

"The plate remains in the vertical vat over night, and preparations are made in the morning to transfer it to the horizontal vat. The furnace is first brought into action. A new plate of blank copper, an inch larger than the matrix, is flattened on the iron table, and bolted to the edges of wooden bars by platinum bolts, for the purpose of preventing the plate from sagging downwards when supported horizontally. The plate so arranged is called the strapped plate. The coated matrix is then taken from the vertical vat, disengaged from its frame, and arranged in the horizontal frame. A wooden wall, an inch high, then surrounds the plate, and on this wall the strapped plate is laid, when the whole combination is placed in the horizontal vat and the connection with the battery established. The positive plate is then taken from the vertical vat and its loss of weight noted and recorded. From the known superficial area of the matrix, the quantity of copper required for a casting one-eighth of an inch thick is computed and recorded. The blank copper consumed in both vats must equal this amount before the required thickness is reached, allowance being made for impurities of rolled copper and roughness on the back of the electrotype. After a few hours of action the strapped plate becomes so loaded with impurities that they will begin to drop on the electrotype; this plate must, therefore, be removed from the vat and a new one immediately supplied. The dirty plate is then washed in the large water tub, and when cleaned its loss of weight is found and recorded. By the amount of loss the action of the batteries is tested, and it is found, if Smee's laws are being observed. Vigilance must now be exercised in watching the batteries and rate of work, and the power must be varied to suit circumstances.

"The entire working battery generally requires renewal once a day, the process being conducted as follows: One zinc and one silver plate are taken from the battery; the silver placed in the solution of chlorid of iron, and the zinc taken to the water tub outside the door of the battery room, where it is scrubbed clean with a hard brush. It is then reamalagated at the quicksilver tub, and taken back to the battery. The silver plate is transferred from the chlorid of iron solution to the adjacent fresh water tub. Another plate is then transferred from the battery to the chlorid solution, and another zinc cleaned, washed, and put back in the battery with the first silver. In this manner the whole battery can be renewed without sensibly interrupting its action.

"When the loss of weight from the rolled copper in both vats indicates that the required thickness of the electrotype is gained, the plate is withdrawn from the battery, detached from its frame, its back smoothed, and its edges filed, until a separation can be made. By separation, the original becomes liberated, and the alto or reversed relief is silvered and electrotyped exactly as an original. The copy from it, or the electrotyped basso, will, if the process has been properly conducted, be a perfect fac-simile of the original, and in hardness, ductility, and elasticity, will equal the best rolled and hammered or planished copper-plate."

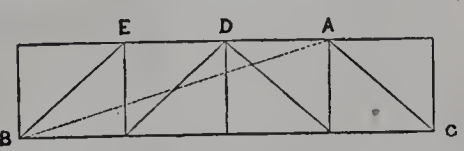
However gratifying the progress of electrotype art has already been, there is evidently much more to be accomplished by its agency in copying all varieties of designs in metals. Electro-stereotyping is already much in use, and must become far more common in this age of large editions. The letter-press and wood-cuts of a popular magazine are now printed from a thin electro-deposited copper layer, backed with a fused metal filling. We confess to a lack of faith in the pretension advanced on the cover to a *new* electrotype process, as the generally known methods are very easily capable of affording the results reached, and the affectation of secrecy which is maintained, is not the sign of a real discovery.

Our own country, requiring such immense issues of popular works, both of literature and of art, would seem to be the natural home of the electrotype, and we feel a well-based confidence that many perfections and amplifications will be given to this beautiful process in the country which has most to gain by its progress. The field of novel applications is by no means yet exhausted, but many hitherto unimagined uses will doubtless spring up, as this art advances to greater perfection and facility.

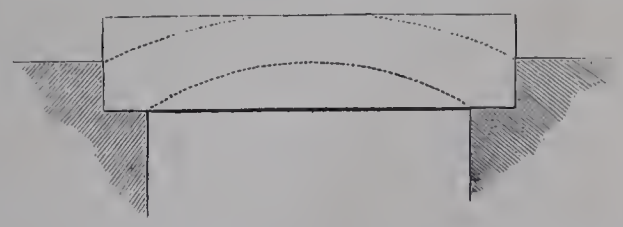
BRIDGES.

TO enable us to examine these important structures understandingly, it is well at first to eliminate a few of the most important general principles governing their construction, and applying the conclusions to the various models illustrating the progress and condition of this branch of engineering science, to decide upon the merits of the various plans exhibited. And although these leading principles may be materially modified, and in particular instances governed by purely practical considerations, yet the infractions induce defects, which should be admitted only under serious necessity, and counteracted by an appropriate remedy. An examination of all these influences cannot be properly made here; and the models before us do not enable us by experiment with them to form an opinion of the structures represented. Besides the difference in workmanship and the omission of joints, fittings, and fastenings in the one, which are matters of necessity in the other, the model is no direct index of proportional strength. The strength of similar beams varies as the breadth and square of the depth, or as the cubes of the diameters, if cylindrical; and inversely as the length. Of two cylinders of similar material and configuration, differing only in size, the strength of the larger strained by its own weight, will be in the inverse proportion to its dimensions. The strength of the smaller cylinder may be represented by $\frac{d^3}{2w}$ (w the weight and l the strength, and d the diameter), and that of the larger, if the dimensions be doubled, by $\frac{8d^3}{2l \times 8w}$ or $\frac{d^3}{2lw}$ or one half of that of the first. To relieve it of formal language; the consideration is, that while the weight is increased eight times by doubling all the dimensions, the like proportion of strength gained by increasing the breadth and depth, or diameter, is lessened by the greater distance between the supports. If, then, the spans of a bridge are doubled or trebled, and the dimensions increased in like proportion, the strength will be but one-half or one-third. A model weighing but a few pounds may sustain several tons without injury, but when enlarged to the size of a useful structure, the same arrangement of material may be incapable of sustaining its own weight.

In an ordinary rectangular beam resting upon supports at the extremities, the lower fibres are in a state of tension, and the upper ones are compressed; and about the middle of the depth, the fibres have little or no strain either of crushing or tensile effect, and contribute but slightly to the strength of the beam. By removing this neutral part, and connecting the remaining upper and lower chords by appropriate ties and braces, in such a manner that the rigidity of the one assists the cohesion of the other, a straight bridge truss is formed of much greater strength than a solid beam of the same weight. This combination, represented in the annexed figure, forms a truss well adapted for an aqueduct or other uniform load. A partial distribution of the load, however, involves an additional consideration which has been frequently overlooked. Let the weight or load be applied at A; it resolves itself upon B and C, the points of support, in the directions A B and A C, and induces a rise of the points D and E, similar to the effect produced on one side of an arch by overloading the other. Owing to the manner of their connections, the braces are not adapted to sustain the tensile force occasioned by this action, and the necessity for introducing iron tie-rods, or wooden counterbraces in the other diagonals of the panels is at once illustrated. Their absence induces a racking strain, which destroys the integrity of the framing, and loosens the courses of the piers.

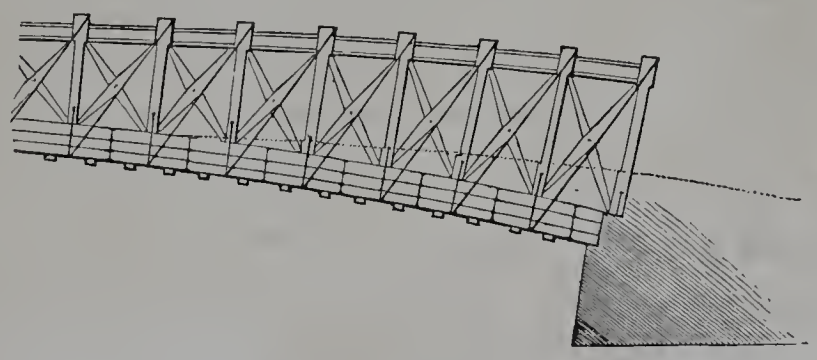


The piers supporting a bridge possess a degree of stability, rendered necessary by obvious causes, which may be made available, and to a certain extent increased, in designing the superstructure, or, as we are now considering the subject, the bridge itself. Suppose a beam resting upon supports: the lower fibres of the beam resist a tensile force, and the supports merely sustain the weight of the beam. Wedge the ends of the beam firmly in the supports, and the lower fibres are compressed and relieved of the tensile strain, and may be removed entirely up to the dotted line; the upper corners also, sustaining no strain, may be removed. We have thus materially lightened the bridge, and rendered it capable of sustaining a greater load, by throwing an additional strain on the piers, which is counteracted by the thrust of the adjacent arches or embankments. The lower curve of the arch is termed the *intrados* or *soffit;* and the upper, the *extrados.* The upper portion of the curve is termed the crown, and the lower parts, the haunches and heels. In a uniformly heavily loaded arch with the intrados of a circular curve, the tendency at the crown is to open the joints, if of stone, at the soffits, and at the haunches, the joints are broken at the extrados. To obtain such a curve for the intrados that the tendency to fracture would be equal throughout the arch, was formerly considered a prime object; but the necessity for adapting



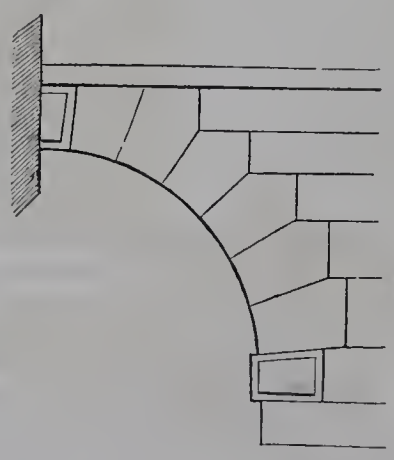
the bridge to the line of the road, and the absence of an equal diffusion of the load, and consequent strains, has led the curve to be disregarded of any purpose other than determining the direction of the courses of the stones, which should be at right angles to the strain. The courses in a vertieal wall, it is obvious, should be horizontal.

In the illustration above, the neutral axis remains tho same after the beam is eonverted into the arch; and as the application of material at the lower part of the arch would be near the neutral axis, and of no utility, it is manifest that the strength should be inereased, as in the beam, by increasing its depth or rise. In parallel, concontric arehes, the lower meets no strain at the centre; and the upper, none at the ends. It is nccessary, however, to adapt the arch to a horizontal road-way, either by direct suspension, as in the aqueduct bridge over the Calder in Seotland, and the Trenton bridge in New Jersey; or by a system of ties and braces forming a truss, affording a mutual support to the arch and road string-pieces, as in the Upper Schuylkill bridge, whieh was designed and built by L. Wernway, and has a single span of 340 feet.

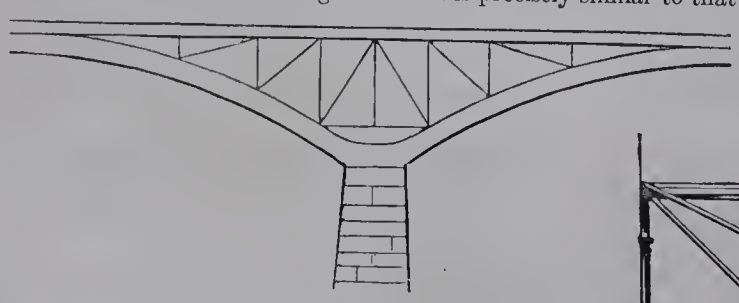


In the consideration of first prineiples alone, we have found the arch to be the best disposition of material; and also that a benefit may be derived from the supports of the road-way being employed as braces to the areh. As the strength of a strueture is the strength of its weakest part, and an excess of strength in any other part is made worse than useless by the injurious weight of the surplus material, it is necessary to connect the systems where a part of onc may be useful to the other, and may be employed without danger of infringing the independence of either.

If one half of an areh be removed, and replaced by a vertieal wall of sufficient stability to resist the thrust of the remaining half arch, there will be no other support needed, and it will stand as firmly as before; showing that while the piers sustain the whole weight of the arch acting vertically in the direction of gravity, there is no direct vertical force acting at the crown. This alteration in the direction of tho strain from the vertical to the horizontal, will obtain in any arrangement of parts. The curve taken by a string, freely suspended at its ends, shows the direction of the forces throughout its length, and the lowest point in the curve is obviously under the action of horizontal forces alone.



When the arch rises above the neutral axis, therefore, there is only a horizontal strain operating at the crown, which can be best opposed by mere area of cross section; and the braces and ties adapted to a vertical strain are there of no use. The heels of the arches support the weight, aeting more or less angularly as the centre of gravity is distant. If the heels of the adjacent arches butted, or were worked together, there would be no necessity for arguing the advantage to be gained by tying the crowns together. Notwithstanding the aetion is precisely similar to that of a tie

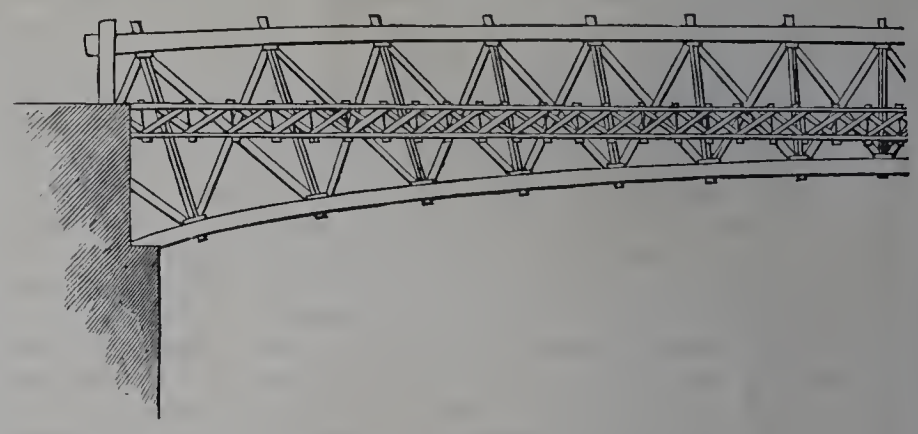


rod of a roof, and the faet apparent to one least in the habit of considering such matters, that the strain is met in a direct line, and the whole construction much relieved by such an arrangement, we frequently find the arches of a bridge made each complete in itself, and neither assisting nor benefiting by its neighbor. We have seen that where there is a tortional or revolving strain about a neutral axis, as in an ordinary beam or straight truss, the depth is the most important element, as the strength inereases in proportion to its square. In tho equilibriated arch every partiele of matter is in a state of compression, relieved at the heels in the arch truss, by the braeing whieh transfers a portion of the strain, and converts it into a tensile force operating in the direction of the ehords, and in some cases almost entirely relieving the abutment of the thrust.

Mr. Haupt, an eminent engineer in extensive practice, states, in a valuable work recently published by the Appletons on this subject, that when a straight bridge settles, the quiekest eurvature is nearest the abutment; and that he has found, in examining a large number of bridges, the joints of the braees near the abutments were invariably compressed and tight, whilst near the eentres there were no symptoms of crushing, and an oecasional imperfeetion in fitting would allow the admission of a knife-blade.

The trussing also permits the applieation of the important principle of eounterbracing which we have before adverted to; and which, by a system of keying to the braces, or serewing to tho iron ties, may compress the arch, and indeed the wholo structure, as if by the application of a load; so that the load itself on its passage relieves the connterbracing to the extent of the artificial load, and is prevented from exereising any lifting motion upon the opposite part of the areh or truss.

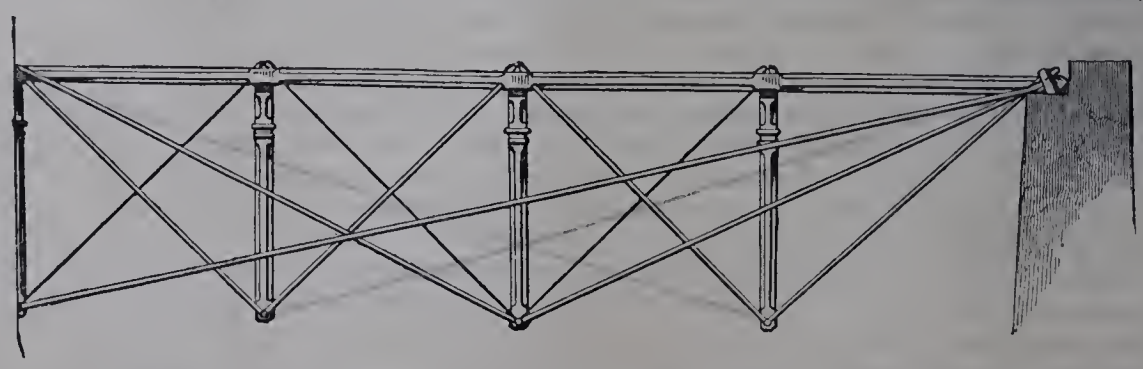
The eonelusions to which we are led by these eonsiderations, which apply more partieularly to wooden bridges, are:—1, the areh, assisted by trussing at the haunches, is the strongest method of disposing of the material; 2, the strain at the erown is horizontal, and best met by direct seetion; 3, the strain at the piers is vertical. and renders the use of ties and braees, as in a truss, most advantageous.



Allen's self-supporting, arch truss bridge. The model is said to be a eorrect representation on a scale of half an ineh to the foot, of a bridge of 190 feet span. It is a light, slender affair, weighing, probably, about 30 pounds, yet it is said to be able to sustain three tons. Experiments of this kind, as has already been shown, are of but little worth; and the value of this model for experimental purposes is not inereased by making up the body of the chords in pieees—the results would have been materially modified, however, had the butting joints been introduced by dividing the pieees longitudinally in the ehords taking a tensile strain. The entire thrust of the areh is transferred by the braces to the upper ehord which operates as a tie-rod. The reduction of the section of the arch and inerease of vertieal timber, by lessening the length of the panels towards the centre of the span, is in opposition to leading principles.

James Scott, of New Lisbon, Conn., exhibits a model of a eombined truss and areh bridge, of which he is the inventor and patentee. The braees and eounterbraees are similar, and starting in the same plane, spring over one another in crossing. The adjoining sets meet in mortiees in the vertical posts or ties, which are half sundered to admit them, and are wedged up by keys.

Bollman's Bridge.—It is a suspension bridge, in which the return ehains or stays, and the anchors are replaeed by a hollow east-iron streteher extending from pier to pier. The vertical posts are also of east-iron, and, by the bottom of each being suspended from both pier-heads, the seetions are supported indcpendently of each other. If a weight be plaeed anywhere but at the centre of a beam supported at both ends, it is unequally distributed; yet in this bridge,



the ties from a post next one of the piers have the same seetional area, although the one to the adjoining pier-head carries nearly the whole weight, and the other extends at a very acute and inefficient angle over the remaining portion of the

span to the opposite pier-head. The floor beams are merely for the purpose of carrying the rail, and, it is stated by the inventor, are not adapted to performing any function of support to the bridge.

Fink's Bridge.—The model of an iron bridge by Albert Fink, of Baltimore, is also a cast-iron trussed girder, similar in principle, but in some respects superior to that at Harper's Ferry. Its construction is shown in the preceding drawing.

Long's Bridge.—The model of an iron bridge invented and patented by Colonel S. H. Long, of the U. S Top. Engs., is exhibited by M. M. White, agent, New-York. It is a variety of the ordinary lattice bridge, which has been a number of years before the public under the name of Rider's Bridge. It is a straight truss with cast-iron upper chords, and vertical ties, and wrought-iron diagonals, and lower chords, counterbraced by keys or wedges at the upper ends of the ties. Owing to the simplicity and similarity of the parts, it is cheaply and readily framed, and for small spans is an economical bridge. But in cases where the magnitude of the undertaking requires the rejection of every pound of useless material, and the employment of the remainder to its fullest extent, an examination of the governing principles of the arch will soon lead to a consideration of the difference of the strains at the crown and the heels, and a disposition of the material to meet them, unlike the uniformity which prevails in this plan.

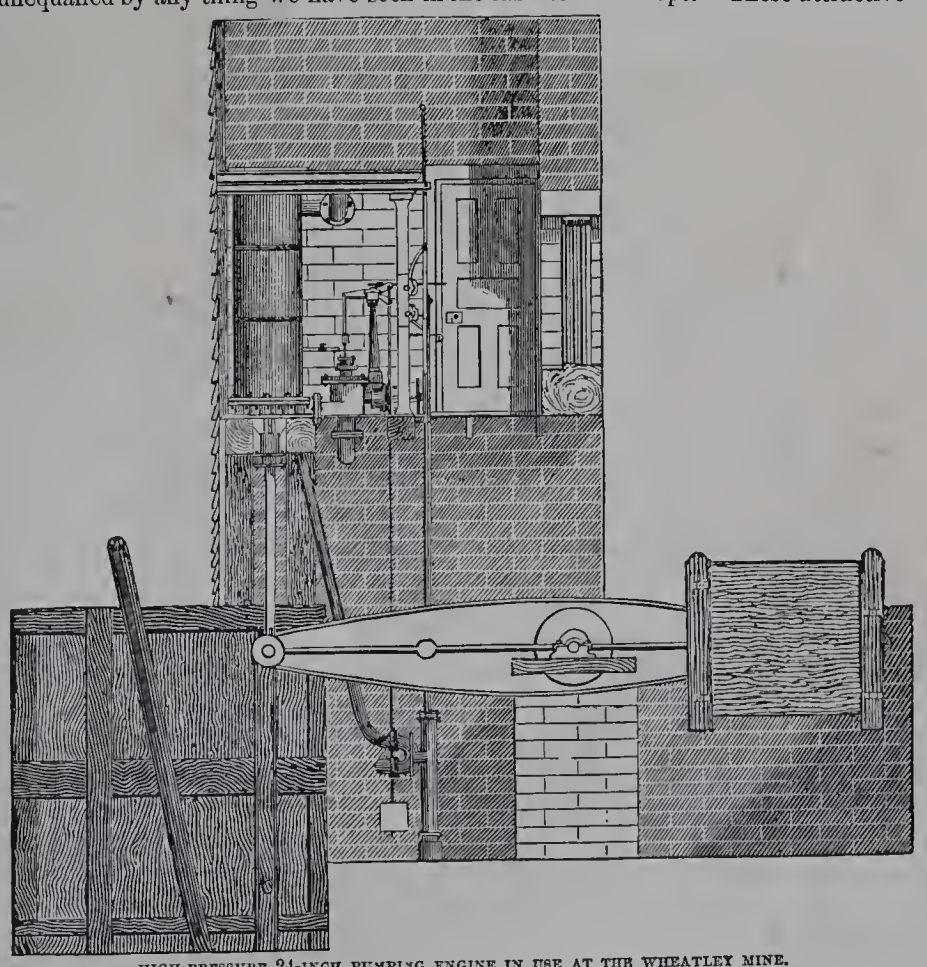
"*Uncle Sam Bridge*," invented by Hammond Howe, of Cincinnati. It is stated by the inventor, that this model of a horizontal truss bridge which may be constructed of wood or iron, is 16 feet long, weighs 63 pounds, and can carry 3448 pounds; it represents a bridge 480 feet long, containing 135,000 feet, board measure, of timber averaging six inches square, and 47 tons of iron, and which will be capable of carrying 10,800 tons. Its distinguishing characteristics are straight lower chords, and arched upper ones, springing from points sufficiently high to clear the roadway, and with a rise nearly sufficient to double the depth of the truss at the centre. The immense span represented by the model, and the employment of small timber, produces an effect of complexity of parts which the structure would not possess. The ties, braces, and counterbraces, are well arranged in sets gradually lessening in lengths towards the abutments, and properly disposing the timbers vertically at the piers, and at their most acute angles near the centre. It is probably overloaded in the middle, and the secondary chord to the upper arch, if the braces are well bolted, is of no utility. The butting blocks at the heels of the braces are superior to the ordinary joints.

PENNSYLVANIA MINERALS.

Mining is a most fascinating pursuit, involving the pleasure of a hazardous adventure and the excitement of successful play. Its profits are sometimes so fabulous, that its losses are overlooked, and men are always ready to venture even with the smallest evidence upon its large and certain expenses. Although America, from its discovery until this day, has furnished the great bulk of the precious metals, mining, as an art, or as a science, has never been well understood here, nor systematically followed—and especially in the United States. Gold being found for the most part on the surface, in the alluvial sands, is extracted by the rudest means and the most unskilful operators—the process being unworthy of the name of mining. The few deep mines in Virginia and the Carolinas, where the gold-bearing rocks are wrought, scarcely form an exception to this remark. The ores of silver, and those of the less valuable metals, are, however, to be procured only by deep mining, and the resources of the United States in this direction have yet to be developed. The galena (ore of lead) of Missouri and the adjacent regions, has been hitherto dug from beds of clay at an inconsiderable depth. There is no regular lode or vein, and the process of procuring it is even less like mining, than the washing of auriferous sands. The native copper of Lake Superior, has no analogy in the previous history of mineral explorations; and while its returns have been in several cases most encouraging, and remunerative to the shareholders, we are still too inexperienced in this new mode of copper-mining to enable us to speak with certainty of its future success.

We are led to speak of this subject by the exhibition of the ores of lead from the Wheatley Mines in Pennsylvania, accompanied by diagrams of the mines, of the machinery used in working them, and specimens of the several products. Pennsylvania has immense wealth in coal and iron, as all the world knows; but her resources in copper, lead, and zinc, are now only beginning to be developed. The collection of Pennsylvania coals and irons, made under the supervision of Dr. C. M. Wetherell, will be the subject of a future notice.

The mineral region where the Wheatley Mines are situated, is in Montgomery and Chester Counties, and occupies a belt of country from six to seven miles long, ranging across the Schuylkill River, near the Perkiomen and Pickering Creeks, in a general east and west direction, and along the boundary of the so-called primary and secondary rocks. The existence of some of the metallic veins of this region has been long known, but it is only lately that a systematic exploration of their contents has been undertaken by Mr. Charles M. Wheatley. Under his judicious management, the chief lode of argentiferous galena has been proved to a depth of over two hundred feet, and a monthly return of about one hundred tons of silver-lead-ore obtained. The mineralogist, and the lover of beautiful natural objects, will see with equal pleasure and surprise the superb crystallisation of metallic salts from these mines, now exhibited in the Mineralogical Department. They embrace the carbonate of lead, sulphate of lead, (anglesite of the mineralogists), phosphates of lead, green, brown, and yellow; molybdate and molybdo-chromate of lead, splendid red crystals; arseniate of lead, chromate of lead, galena, bars of silver obtained from the galena, and various other products less attractive to the uninstructed eye. We speak understandingly and without exaggeration, when we say that the sulphates and molybdo-chromates of lead in Mr. Wheatley's collection, are the most magnificent metallic salts ever obtained in lead mining, and unequalled by any thing we have seen in the cabinets of Europe.* These attractive



HIGH-PRESSURE 24-INCH PUMPING ENGINE IN USE AT THE WHEATLEY MINE.

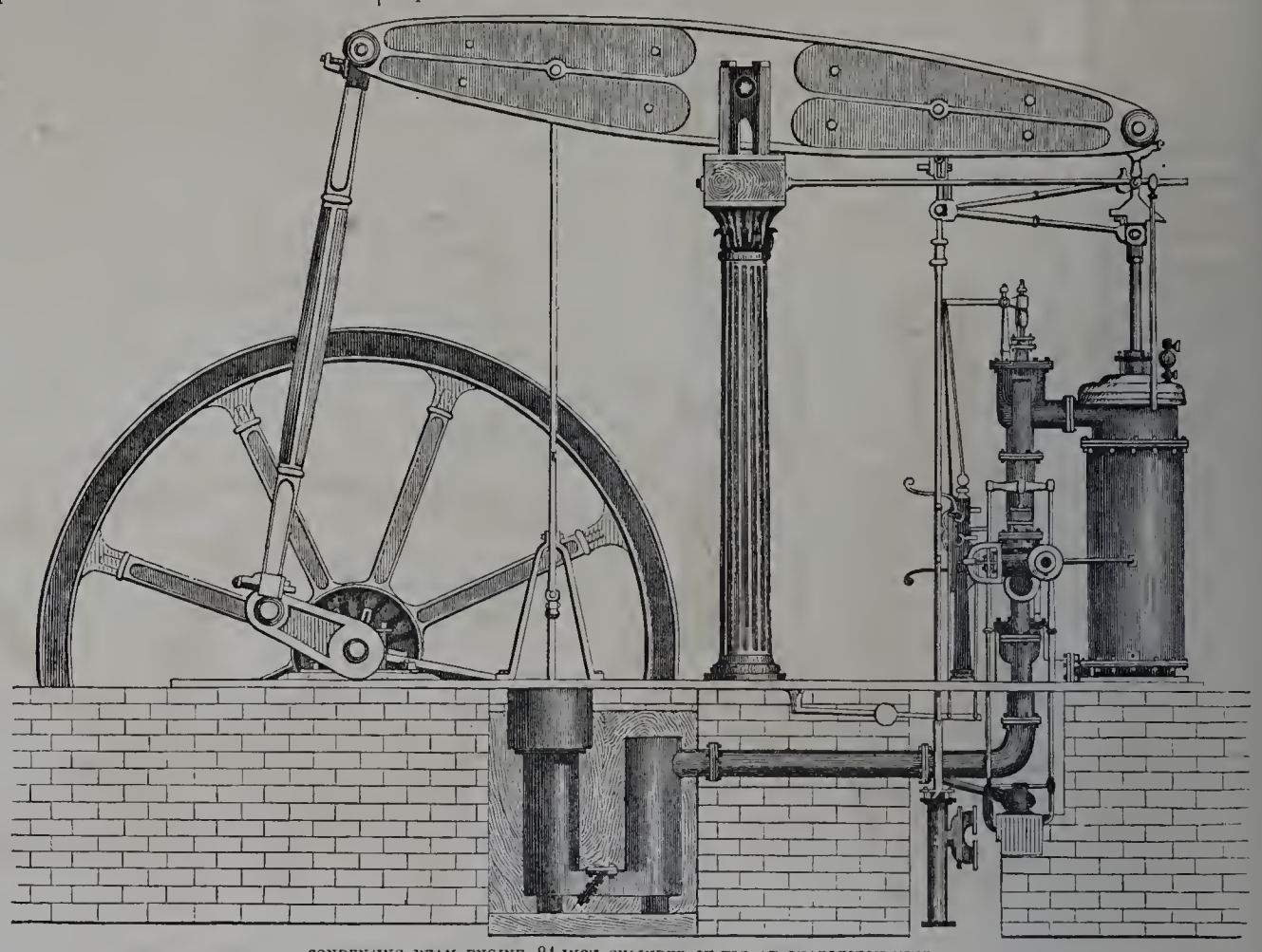
*[Selecting the Wheatley Lode as presenting perhaps the greatest diversity of species, and as that which has received the closest study, we find the mineralogy of these veins represented by the following large and interesting catalogue of species:—

Sulphate of Lead Crystallised,
Carbonate of Lead "
Phosphate of Lead "
Arseniate of Lead "
Molybdate of Lead "
Chromomolybdate of Lead,
Arseniophosphate of Lead,
Sulphuret of Lead,
Antimonial Sulphuret of Lead and Silver,
Sulphuret of Zinc,
Carbonate of Zinc,
Silicate of Zinc,
Sulphuret of Copper,
Green Malachite,
Blue Malachite,
Black Oxyd of Copper,
Native Copper,
Oxyd of Manganese,
Native Sulphur,
Native Silver,
Quartz crystallised,
Cellular Quartz,
Oxyd of Iron with Silver,
Brown Hematite,
Brown Spar,
Sulphate Barytes,
Iron Pyrites.]

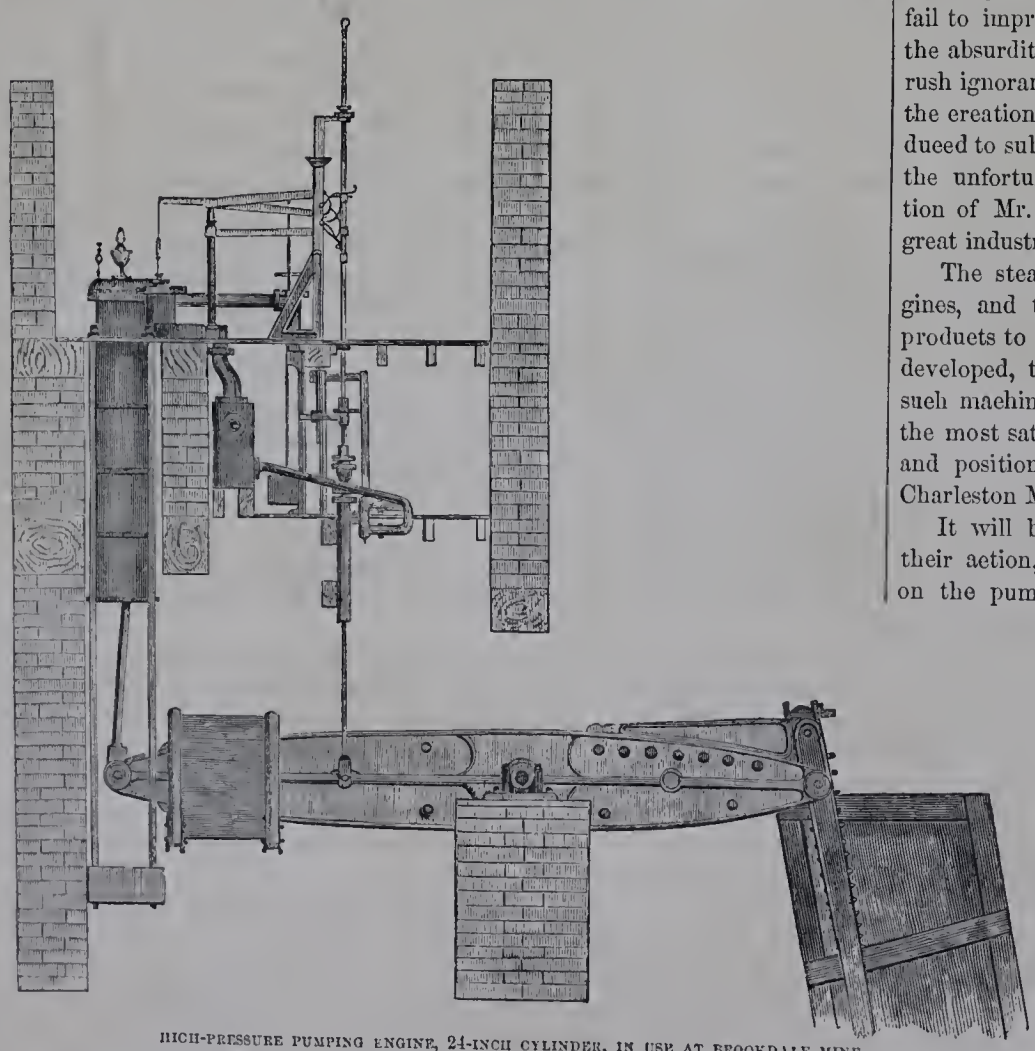
erystallisations possess, howevor, far more interest for the ehemist an mineralogist than for the eeonomist, who will see more hope of future returns to shareholders in the lumps of solid galena, and the bars of white silver, than in the brilliant faeets of the gems before named.

The inexperieneed in sueh matters will learn with interest, however, that these flowers of the earth's dark reeesses have a high eeonomieal value as indieating the existenee of solid and enduring mineral wealth below. In the ehemieal and geologieal antagonism, whose energies sent up to the surfaee the mineral veins from the deep interior, the more volatile and easily exhaled eompounds have sought the upper surfaee. The air and the atmospheric waters also have penetrated to a eertain depth, in the eourse of the veins, produeing ehanges in their eontents, the most remarkable of whieh is the washing out and removal for the most part of the metallie substanees. These veins, therefore, near the upper surfaee, present only a dull mass of eellular quartz, whose eavities are filled with yellow ochre, or dull blaek powders of tho oxyds of iron and manganese, with hero and there, perhaps, a metallie spangle, or stain. The eye of the experienced miner rests with delight on these ugly *gozzans*, as he calls them, in the provineial dialeet of Cornwall—for he is sure of sueeess in depth where the surfaee offers sueh promise. Sueeeeding these dull and unattraetive signs, of whieh Mr. Wheatley's eolleetion presents speeimens, are found the elegant salts before mentioned, but lower down at the depth of some hundreds of feet, heavy masses of galena and of other sulphur eompounds of the metals, fill the rieh portions of the vein, and offer the safest assuranee of eontinued wealth.

The geology of this metalliferous distriet of Pennsylvania, has been studied lately by Prof. H. D. Rogers, who has made a speeial report to the proprietors upon it. From this report, and our personal knowledge of the distriet, we have drawn what has been said. The elaborate maps of the region, construeted upon the plan of the ordnanee survey maps of Great Britain, will be observed, suspended in the Exhibition, and upon them the metallic veins are traeed in gold. We are happy to have it in our power to eall public attention to this subjeet by so good an example of patient and skilful development at our own door. To give more distinetness to the matter, we have caused some of the diagrams of the mining machinery, used at the Wheatley Mines, to be engraved for this artiele. Although sueh drawings may be of no special serviee to the experieneed miner, they eannot fail to impress those who havo had no previous knowledge of the subjeet with the absurdity (not to say the eriminal disregard of others' interests), of those who rush ignorantly into the business of mining explorations, with no other idea than the ereation of some temporary exeitement, during whieh innoeent persons are indueed to subseribe shares, with the eertainty of failure before them. In view of the unfortunate frequeney of sueh examples, we hail with pleasure the exposition of Mr. Wheatley as a tokens of some sure progress made in one of the great industrial and produetive arts of this eountry.



CONDENSING BEAM ENGINE, 24-INCH CYLINDER, IN USE AT CHARLESTON MINE.



HIGH-PRESSURE PUMPING ENGINE, 24-INCH CYLINDER, IN USE AT BROOKDALE MINE.

The steam engines employed hitherto in this region are high-pressure engines, and they have been used alike for pumping and for raising the mining produets to the surfaee. Hereafter as the resourees of the region are more fully developed, the mueh more eeonomieal Cornish engine will be employed. One sueh maehine is indeed already in motion at the Perkiomen Copper Mine with the most satisfaetory results. Below are given figures showing the construetion, and position of the steam engines in use at the Wheatley, Brookdale and Charleston Mines. Also a tabular statement of the duty performed by eaeh.

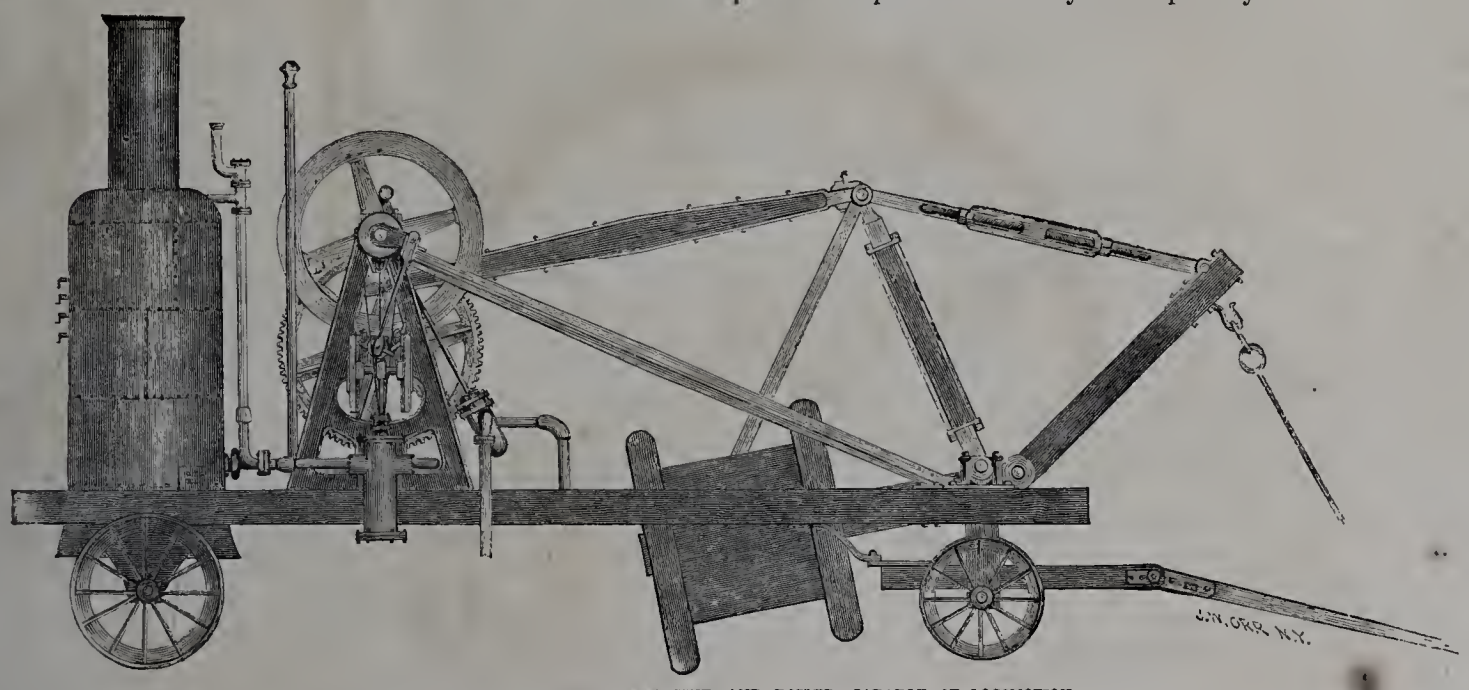
It will be observed that all these engines are automatic or intermittent in their aetion, remaining inaetive until a eertain load of water has aeeumulated on the pumps, when "a float" releases a lever eommunieating with tho steam "eut-off," and a motion of the piston relieves the pumps of their burden, and the maehinery is again quiet until a fresh aeeumulation. The great eeonomy of fuel, and of wear and tear in sueh an arrangement must be obvious, as eompared with a regular continuous motion, having no regard to the work to be done.

This engine is situated on tho same vein or lode as the "Wheatley," and is distant from it 2,076 feet in a southwesterly direetion. It will be observed that this engine works upon the dip or "underlie" of the vein, whieh is here about eighteen inches in a fathom. Between those two engines, at a point nearly midway, and on the same vein, a very large shaft is now in proeess of being sunk, over whieh is to be plaeed a first-elass Cornish engine, with the design of draining the entire lode. When this is aeeomplished, the engines before deseribed will be used only to raise the produets of the mine to the surfaee. The proposed Cornish pumping engine is to have a diameter of eylinder of 80 inehes, and a stroke of 12 feet.

About half a mile westward of the Wheatley and Brookdale Mines, whose engines have just been deseribed, exists another powerful silver-lead lode strietly parallel to the first named. This is ealled the Charleston vein. It has as yet been ex-

plored to a less extent than the "Wheatley," both in depth and horizontal reach, but the results are every way encouraging. The mineral contents of the vein, its gozzans, and its bounding walls, make it a counterpart of its more eastern neighbor. About 1700 feet of its horizontal range, and 180 feet in depth have been explored, and the main shaft is being sunk with activity.

The accompanying figure is a proportional sketch of a condensing engine of 24-inch cylinder which has been erected over the Charleston Mine. This is what in Cornwall is called a "Whim Engine" (i. e. an engine for moving the "whim," or apparatus by which ore and rubbish is raised from a mine). In a more advanced stage of explorations, a pumping engine will be added, and then the present machine, which now does all the work, will be restricted to its appropriate function.



EXPLORING HIGH-PRESSURE ENGINE AND BOILER, CAPABLE OF LOCOMOTION.

The above figure represents a very convenient and economical form of "Exploring Engine." which has proved of great service where explorations were to be made prior to the erection of more expensive and permanent machinery. It is easily transported from place to place by horse power, and will serve to drain and sink a shaft from 70 to 100 feet in depth.

The following tabular statement will show the duty of the several engines just mentioned—working under one-third "cut off."

Names of Mines.	Diameter of Cylinder.		Length of Stroke.	Load in lbs.	Gallons of water lifted per min.	Cwt. of Coal consumed per 24 hours.	Millions lbs. lifted one foot high per cwt. coals.
	Inch.	Strokes per. min.	*Feet.*				
Wheatley Mine.	24	10	6	8360	360	2300	31.4
Brookdale Mine.	24	6	8	4410	216	1500	15.2
Charleston Mine.	24	6	5	6490	216	1200	28.

This duty is very much below that of the Cornish pumping engines, the best of which raise for every bushel of coal consumed, one million of pounds one foot high in a minute.

The depth of the several shafts, at these mines, on the first of July, was as follows:

The Wheatley, - - - - - - - - 240 feet.
" Brookdale, - - - - - - - - 120 "
" Charleston, - - - - - - - 120 "
3 do. do. each, - - - - 50 "

Besides 1 of 60, 1 of 90, and 1 of 100 each.

The total length of adit levels driven in these mines, up to the same date, was 3519 feet. About 1000 tons of lead have been raised and sent to market during the explorations, which the owners regard as only preliminary to the more vigorous and productive workings of the mines.

As already remarked, the more easily volatilized of the lead ores, and those resulting as secondary products from the decomposition of galena by atmospheric causes, occupy the upper and less productive portions of the veins. It is remarkable that among these the phosphate of lead should occupy so prominent a place—forming not less than three-fourths of the whole metallic product of the upper levels. It is a curious subject of scientific inquiry, from whence came such enormous quantities of phosphoric acid? But a question of much more practical and economical interest is—"Cannot the process of smelting these ores be so modified, that the phosphoric acid may be secured in a form of combination fit for the purposes of the agriculturist?" The whole world has been searched during the past ten years for new sources of supply for this indispensable ingredient of all fertile soils. Is it not possible that this may be a new source, or one hitherto overlooked?

It is proper to advert before closing this article, to a few facts upon the general geology of this district, and of its metallic deposits which are of equal practical and scientific interest. We will endeavor to make these statements as simple and untechnical as possible. In the previous part of this article, it was stated that the mineral veins of this district passed uninterruptedly out of the gneissic strata (rocks belonging to the granitic family) into the red sandstone, adjacent. Now it is a curious fact, worthy of much attention, that the metalliferous veins, so long as they remain in the gniessic rocks are *lead-bearing* veins; that as soon as these same veins pass the boundary of the primary and enter the red shales, the character of their metallic contents is changed, and they become *copper-bearing* lodes. This general statement is subject to some exceptions, but it is, at the same time supported by so many remarkable confirmatory instances, that there can be little hesitation in accepting it as the law of the district.

The question of the geological age of metallic deposits has always been considered one of the greatest practical and scientific importance. The Perkiomen district furnishes us some facts of singular interest bearing upon this question. The red sandstone deposits, into which the metallic veins have been intruded from the underlying primary rocks, belong to the period known to European geologists as the *triassic*, but more familiar as the new red sandstone, a deposit more recent than the coal measures. Now it happens that this quarter of Pennsylvania is intersected by numerous veins of igneous origin, familiarly known by the name of trap dykes:—it is obvious, on reflection, that inasmuch as these trap dykes intersect alike the primary and secondary rocks, that the fissures which they fill must have been formed subsequent to the laying down of the sedimentary strata, in other words, the instrusive rocks are more recent in their geological age than the new red sandstone. The bearing of these facts upon the subject under consideration will be understood, when it is known that in the exploration of the Wheatley lode, three of these trap dykes have been discovered, intersected and displaced by the metallic vein. Moreover, such was the force producing the fissures now filled by the metallic lode, that the corresponding or opposite parts of the two walls, have been heaved or displaced horizontally, in one instance more than fifty-six feet out of their original position.

These facts show not only that these metallic veins are more recent in their origin than the sedimentary deposits through which they are injected, but also more recent than the system of intrusive rocks. The same system of new red sandstone rocks accompanied by the intrusive trap dykes, is common also in the valley of the Connecticut, and in the State of New Jersey. In both of these places, indications of copper exist along the lines of junction of the several members of the system, but they nowhere show a disposition to form well-defined courses of a metallic character.

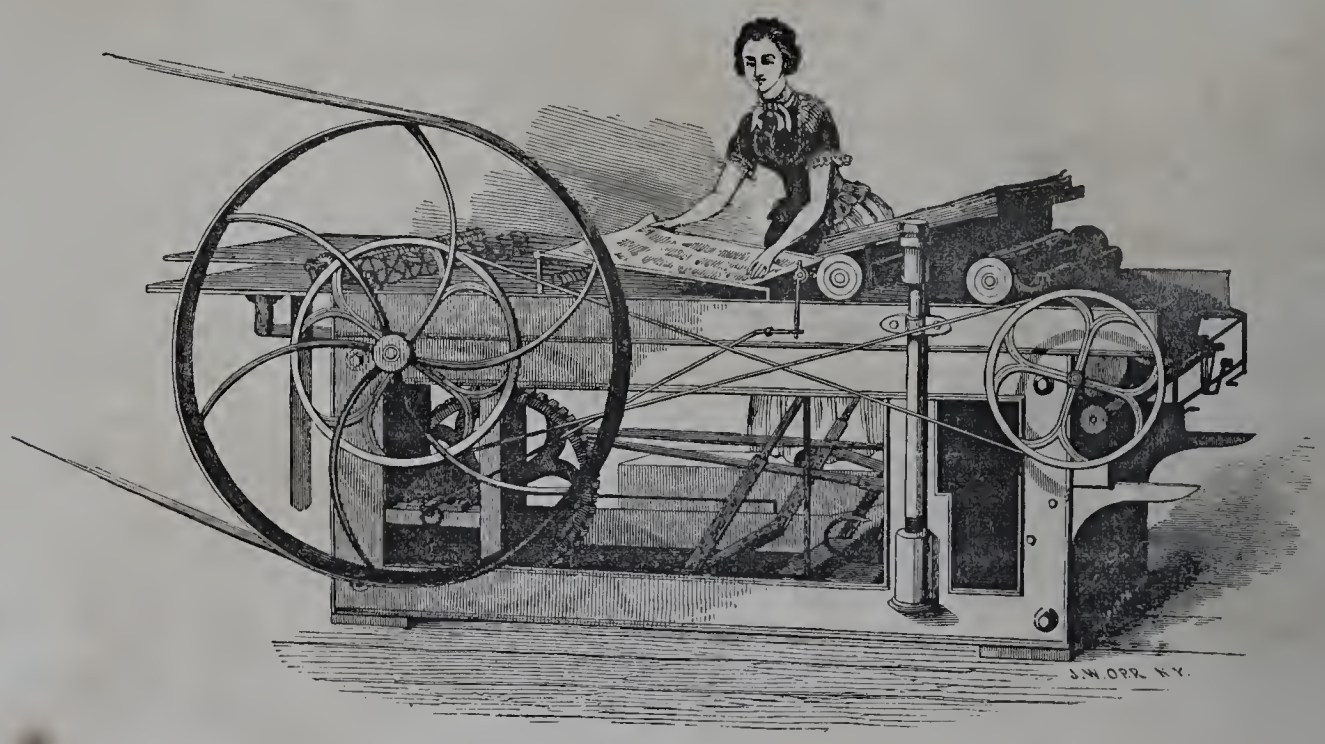
It is the opinion of Prof. Rogers, that the metallic vein-fissures of this region were formed and filled during the long period when the eastern slope of the Alleghanies was still beneath the ocean, from whose waters were deposited the extensive belt of tertiary and cretaceous strata bordering the Atlantic border of North America. The effect of the oceanic overflow appears in the very extensive and deeply penetrating decomposition which the gneissic strata of this region have suffered, yielding to the landscape those soft and beautiful swells and outlines for which this fine agricultural district is remarkable.

We would refer those who desire more particular information on this subject, to the reports of Prof. Rogers already so often alluded to.

PRINTING.

THE Art of Typography is illustrated in the present exhibition by the type-founding apparatus of the Messrs. Johnston, of Philadelphia, and by the printing presses of I. & S. Adams & Co., of Boston, and A. B. Taylor & Co., New-York. The presses are driven by steam, and are in constant operation at the Crystal Palace, in the East Nave. The HAND CATALOGUE and the ILLUSTRATED RECORD, are printed upon them under the superintendence of J. F. Trow, of New-York. A brief description of the peculiarities of these machines is all that we propose to attempt; the general principles of printing presses are so universally known that they need no detailed account or illustration at our hands.

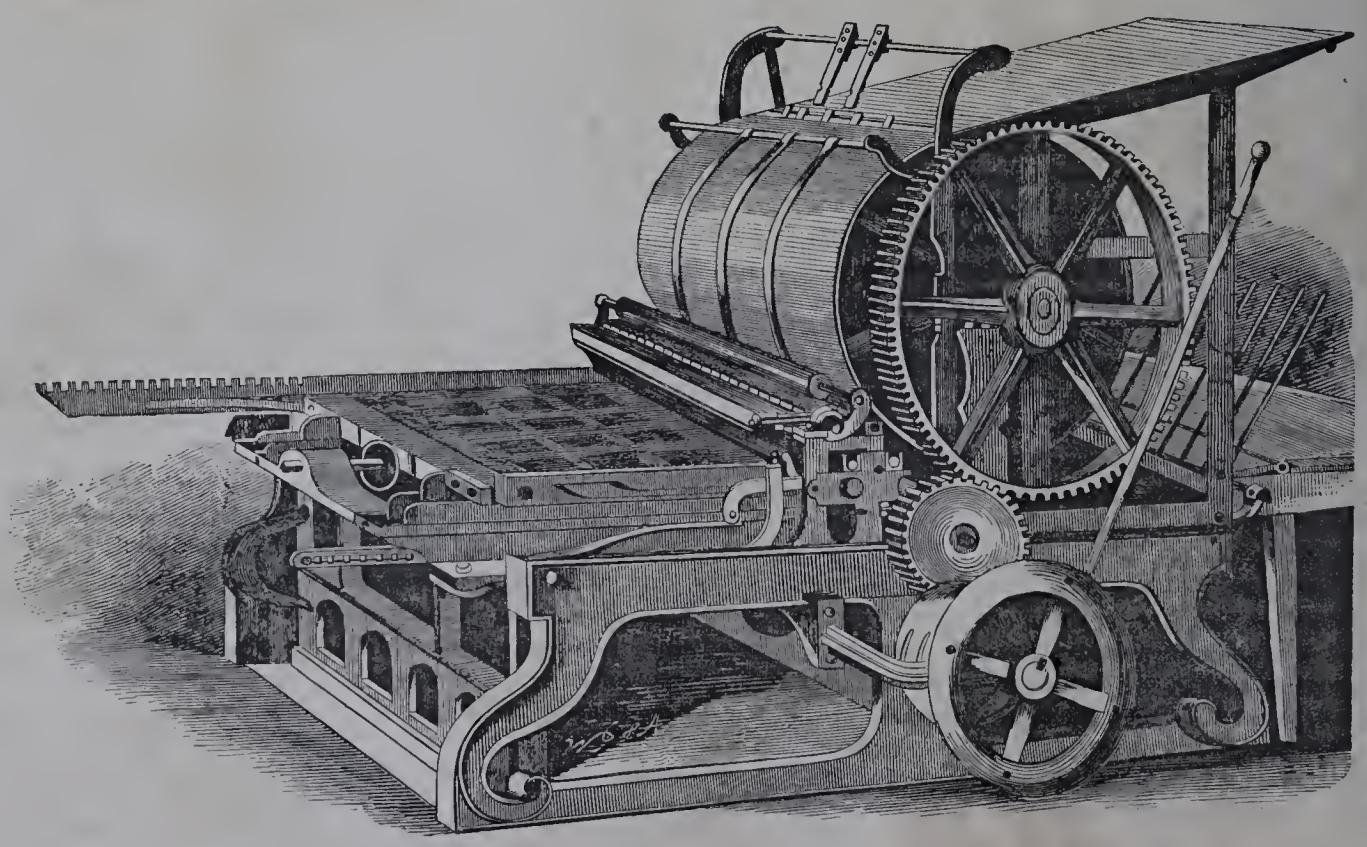
Adams' Press.—This machine, of which we annex an engraving, was invented and manufactured by Mr. Isaac Adams, of Boston, and is known more especially as "Adams' new Patent Power Printing Press."—Some of its peculiarities were introduced to the public in 1830, and were then patented, but most of them were brought out in 1836, when another patent was granted to Mr. Adams, which in 1850, was renewed for the term of seven years.



The press requires the attendance of only one person, usually a girl, whose duty it is to supply the sheets of paper, one by one, to the "pointing board," from which they are taken by little iron fingers or nippers, and carried beneath the platen. As each sheet reaches this place, the bed of type is elevated to meet the paper and impress it. After impression, the sheet is borne on for some distance by a "frisket," which moves in a horizontal direction; by a blast of air received from a bellows, it is raised from the frisket on to rollers, which carry it to a "fly," and this last contrivance throws all the sheets upon a table, and piles them there compactly.

Meanwhile the bed of type has been inked by the rollers, and by the time a second sheet has reached the platen the bed has returned to its place, and is ready to make a new impression. The ink is very carefully distributed over the face of the type by a well-adjusted system of rollers, from two to six of which, in the various machines of this patent, are made to pass over the form. By this means the complete and even distribution of ink, so essential to printing fine engravings, is readily produced. The illustrated pages of the RECORD are printed upon this press.

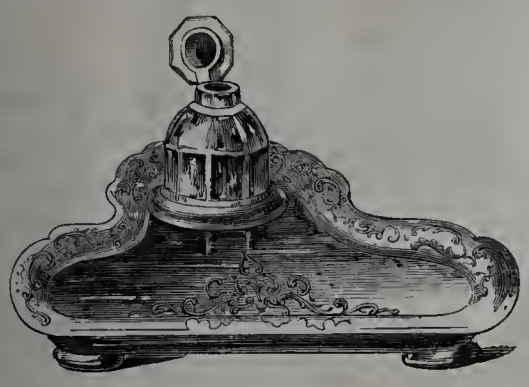
Taylor's Press was manufactured and invented by A. B. Taylor, of No. 5 Hague-street, New-York, and is definitely known as a "large single-cylinder printing machine." The engraving at the foot of the page illustrates its general appearance. The sheets to be printed are placed one by one on the table at the top of the machine, from which they are taken by the five clasps or fingers, which are seen in the cut, and brought upon the cylinder. As the cylinder revolves, the bed of type which is seen at the left in the engraving, is brought beneath it, and conveys its impression to the revolving paper. Only one revolution of the cylinder is required for a single impression. The sheets thus printed are carried forward by the "fly" to the table at the right, while the bed of type returns to the left to receive the ink for the new sheet of paper already prepared for it. The machine is provided with two large and two small vibrating ink-distributors, and four composition rollers for inking the form.

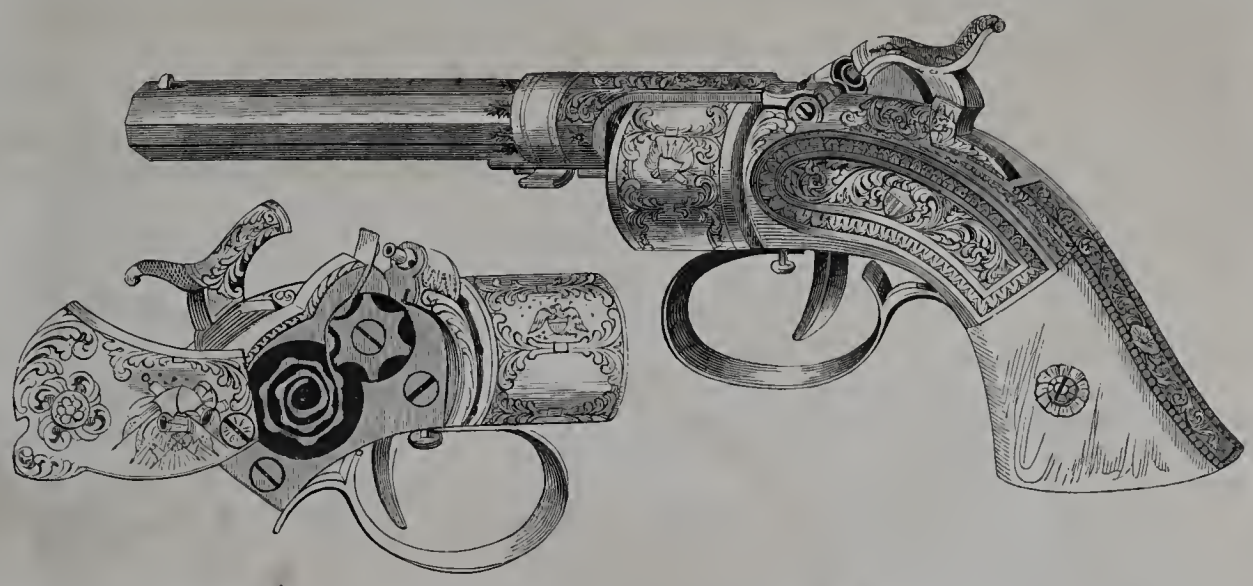


One peculiarity of this machine is in the air springs, attached to it for resisting the great momentum which the bed of type acquires in passing to and fro beneath the cylinder. They consist of horizontal hollow cylinders, which are attached to each end of the bed of type, and have piston rods or plungers, fitted accurately to them. These plungers are fixed in the framework of the machine, and as the bed of type approaches either end, the piston there placed compresses the air within the cylinder, so as to resist the momentum of the bed of type as effectually as a spring, but without its liability to disarrangement. The amount of pressure may be very readily adjusted to any extent which is required by means of screws.

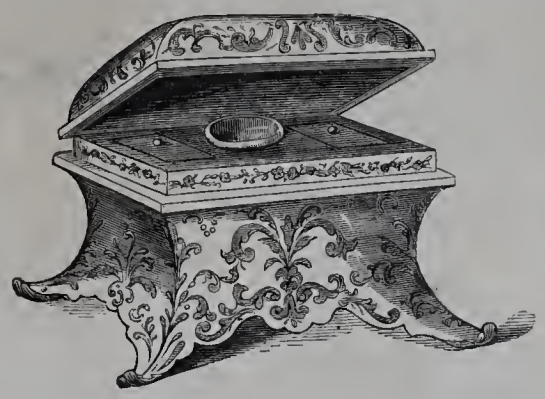
Of the beautiful articles made of papier maché we have selected for this page five objects from the contributions of Messrs. JENNENS & BETTRIDGE, of Birmingham and London. These gentlemen are the largest manufacturers of papier maché in England, and during the fifty years of their establishment, their enterprise and taste have introduced many improvements, and greatly extended the trade, by adapting this material to an endless variety of useful and ornamental objects.

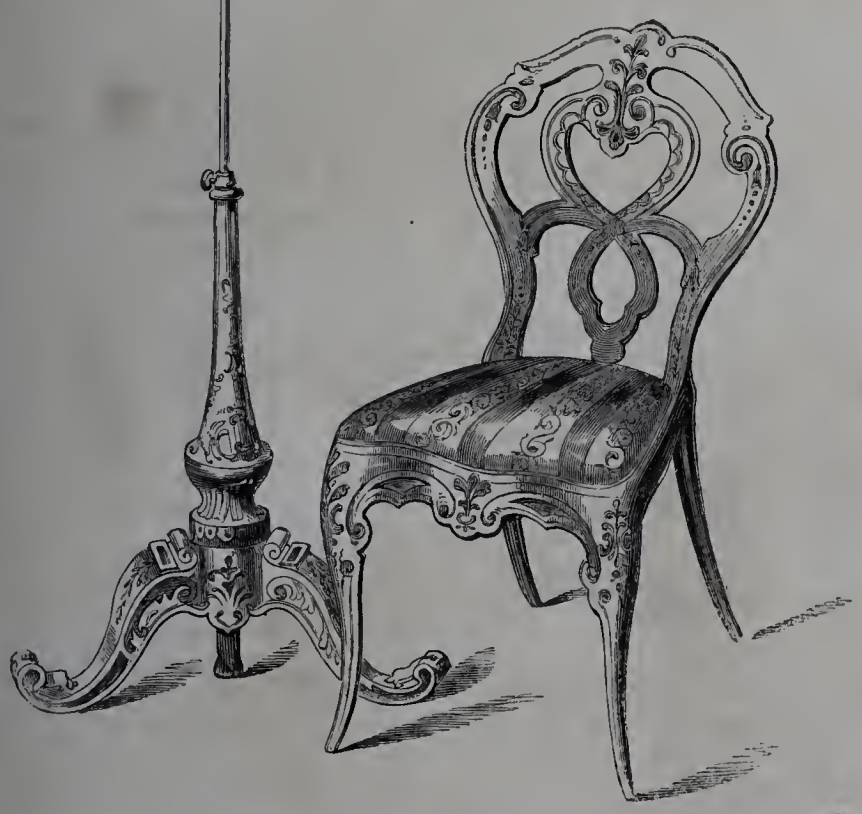
AN INK STAND, a TEA CADDY, a highly ornamented SCREEN, and parlor CHAIR and TABLE, which we engrave, will illustrate the variety of the works which they produce They were awarded a prize medal at the Exhibition of 1851.

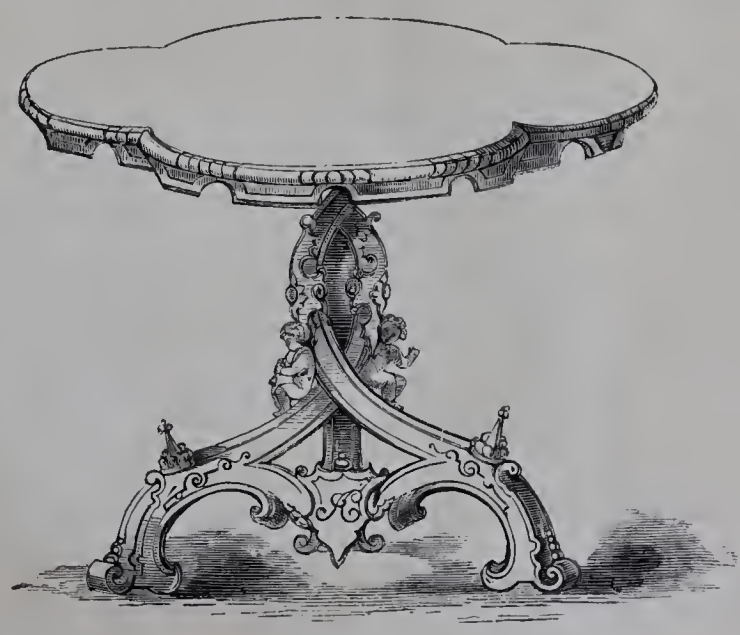




The process of inlaying papier maché with pearl was invented by Messrs. Jennens & Bettridge, and patented by them about twenty years since. It is quite a simple and easy process, and does not consist in cutting out the material for the insertion of the inlaid substance, as the name indicates, but the pearl is held by adhesion only. It is done in the following manner:—the article to be ornamented is covered with a thin coat of copal or other varnish, which serves to retain in place the pieces of pearl, previously cut into the required size and shape from the nacre of shells. When all the pieces of the design have been laid on, repeated coats of tar varnish are applied until the interstices are completely filled, and the pearl covered. The article is next ground with a pumice stone until the extra varnish is removed, and a uniform surface produced, with the exposure of the design. The surface is then polished with a rotten-stone, and finally finished by "handing," or polishing by the hand. The process of gem inlaying is another invention by the same firm, which they have recently patented.

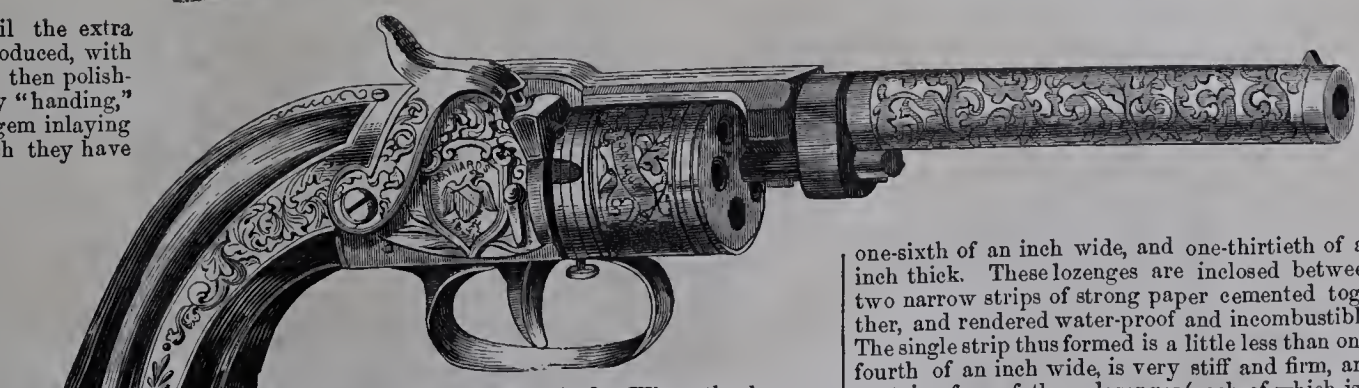






The PISTOLS which commence and end this page, present another variety of the repeating arms, for which America has become famous. They are manufactured by the Massachusetts Arms Company, at Chicopee Falls. The upper one particularly is very beautifully finished. The chief peculiarity of these pistols consists in the Maynard Primer, whose arrangement will be seen in the engraving.

One of these strips, containing fifty charges, is coiled up and placed in a magazine in the lock, and is *fed out*, by the action of the lock, one charge at each time the hammer is raised. When the hammer descend s it cuts off and fires the charge fed out upon the vent or cone, thus igniting the cartridge within the barrel.



The detonating material of the "Maynard Primer" is in the form of *little lozenges*, each about one-sixth of an inch wide, and one-thirtieth of an inch thick. These lozenges are inclosed between two narrow strips of strong paper cemented together, and rendered water-proof and incombustible. The single strip thus formed is a little less than one-fourth of an inch wide, is very stiff and firm, and contains four of these lozenges (each of which is a *charge*) in every inch of its length; the charges forming projections, of their own shape, on one side, having considerable and equal spaces between them; the other side of the strip being one flat and even surface.

On this and the opposite page we engrave two statues which adorn the Austrian department of the Exhibition, although they are the work of an Italian, GUISEPPE CROFF, of Milan. The one represents a boy seated upon a tortoise, with one hand guiding his slow-paced steed;

and the other, a boy upon a huge craw-fish or lobster, and apparently amusing himself with the struggles of his captive.

The GAZELLE WAGGON, made and exhibited by G. W. WATSON, of Philadelphia, is a meritorious specimen both

of the excellence of our native materials, of which it is entirely composed, and of the beauty which they may receive from the skill of our mechanics. It was also exhibited at the World's Fair, of 1851, and there received a prize medal. The body is made of American walnut and hickory, and the running gear of white hickory. Both are highly polished, and ornamented with carving and solid silver mountings; but no paint or varnish deforms the native beauty of the wood. The patent leather top, and the linings, are tastefully stitched and embroidered with national emblems.

On comparing the art of carriage-building of no very distant times with the present, it will be seen that it has

been greatly improved, especially in combining lightness and strength. This is more apparent in carriages made in the United States than any where else, and our builders have been greatly aided in attaining this superiority by the unrivalled excellence of the wood (hickory) furnished by our forests.

The ANTIQUE CLOCK, made in 1509, is exhibited by JEROME, the well known manufacturer of clocks in New Haven. The case is oak, and its rude, quaint carvings are in striking contrast with the smartness of its modern companions.

The EBONY CABINET, also an antique, if we may judge from its appearance, is exhibited by R. J. GAMELKOORN, of Arnheim, Holland. It is elaborately and grotesquely carved in fanciful scrolls and figures, among which we distinguish huntsmen, and a stag and wild boar at bay.

From the first introduction of portable fire-arms numberless attempts have been made to increase their destructiveness by giving to one instrument the power of many; but it was left to American ingenuity to carry out the idea with practical success. The latest of these novelties is exhibited by the inventor, Mr. E. Whitney, of New Haven. The chambered cylinder is detached for loading by removing the centre-pin on which it revolves; when in place it is turned by the thumb or finger to the right or left, as may be desired. This repeater is discharged less rapidly than Colt's, but it is also much stronger and simpler in its construction, and therefore less liable to be injured by use, or if so, it may be easily repaired.

The Caster, engraved on this page, was made by the Ames Manufacturing Company, Chicopee, Mass. It is

wrought in solid silver, and we are assured that it exhibits good workmanship. We cannot help expressing our regret that skill and labor of any kind should have been wasted on a design of such unequivocal and unmitigated absurdity. It has neither beauty nor fitness, but every artistic propriety has been sacrificed to carry out a paltry and puerile conceit. In works in the precious metals, we are entitled to expect a grade of art corresponding to the rich and costly nature of the materials, and in articles of table furniture, we also require a design in harmony with their obvious uses. Three wild cats, turned tail foremost towards the trunk of a tree, and snarling at two others in its branches, form a group which would be ridiculous wherever perpetrated, but when they are stuck upon the foot of a caster, and made to decorate (?) a dinner-table, the conceit becomes offensive as well as absurd. What possible connection is there between a group of cats and a vinegar cruet or pepper box? A caster requires to be lifted, and needs a handle smooth and convenient to the hand; but here we are treated instead to a twist of two branches with rough and sharp projections, impossible to grasp with comfort, and, as though this were not enough, two cats are added, struggling over some nondescript animal which they have caught.

The statue on the right of the page is the work of Signor Piatti, the superintendent of sculpture. It represents the son of an Irish farmer, during the late years of famine.

Works in the precious metals occupy no inconsiderable space in the exhibition, and attract attention by their beauty and the great intrinsic value which they represent. In the American department, and to some extent in the English, they are more remarkable for their value as bullion than as works of art. In works of this

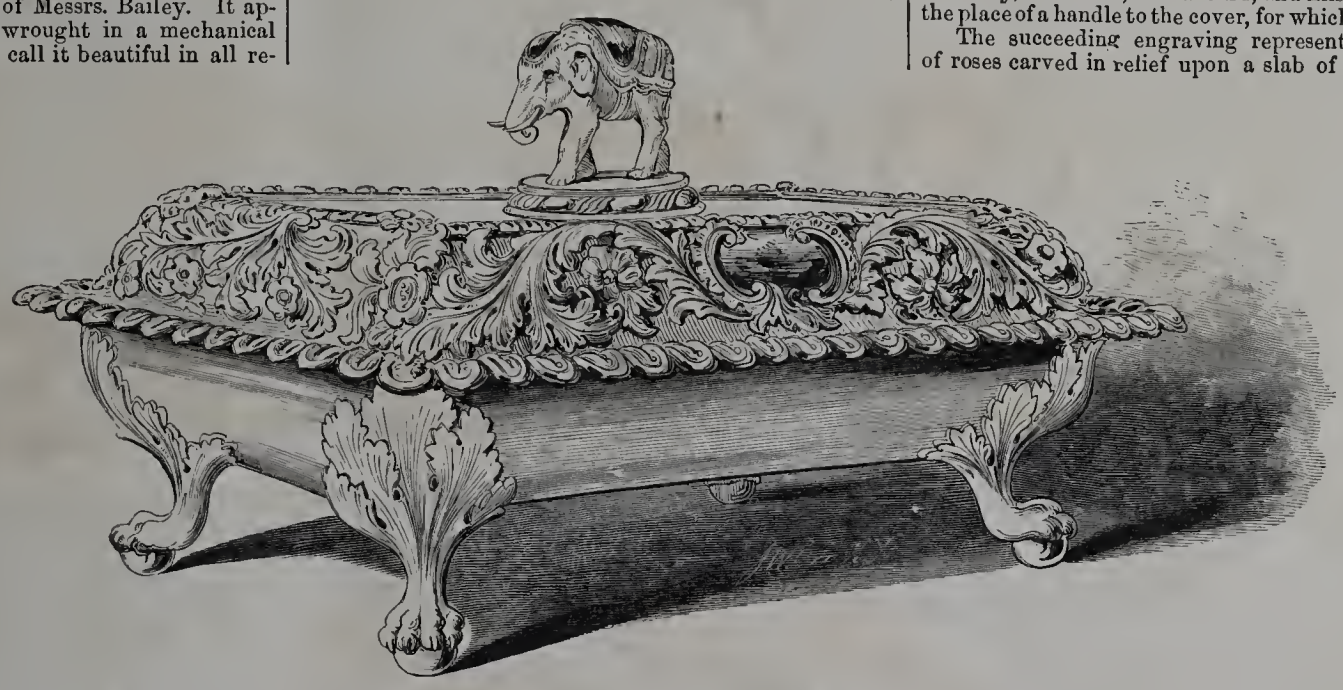
kind, as we have before remarked, we are not satisfied with ordinary artistic merit. The ornament must be so rare and rich in design and execution as to give additional value to materials already rich. The workmanship should be more precious than the metal which receives it

We introduce upon this page favorable examples from the American department. The silver Breakfast and Tea Services, and the Coffee Urn, are contributed by Messrs. Bailey & Co., of Philadelphia, who are, we understand, extensive manufacturers in that city.

The large and massive silver Salver, occupying the centre of the page is selected from the case of the Messrs. Garrard, of London.

The large Silver Dish which commences this page is also from the manufactory of Messrs. Bailey. It appears solid, massy, and well wrought in a mechanical point of view, bnt we cannot call it beautiful in all respects. The figure of an elephant which surmounts it, is clumsy, awkward, and absurd, and fills ill, or not at all, the place of a handle to the cover, for which it was designed.

The succeeding engraving represents a composition of roses carved in relief upon a slab of Carrara marble.



It is the work of Signor Zaccagna, of Carrara.

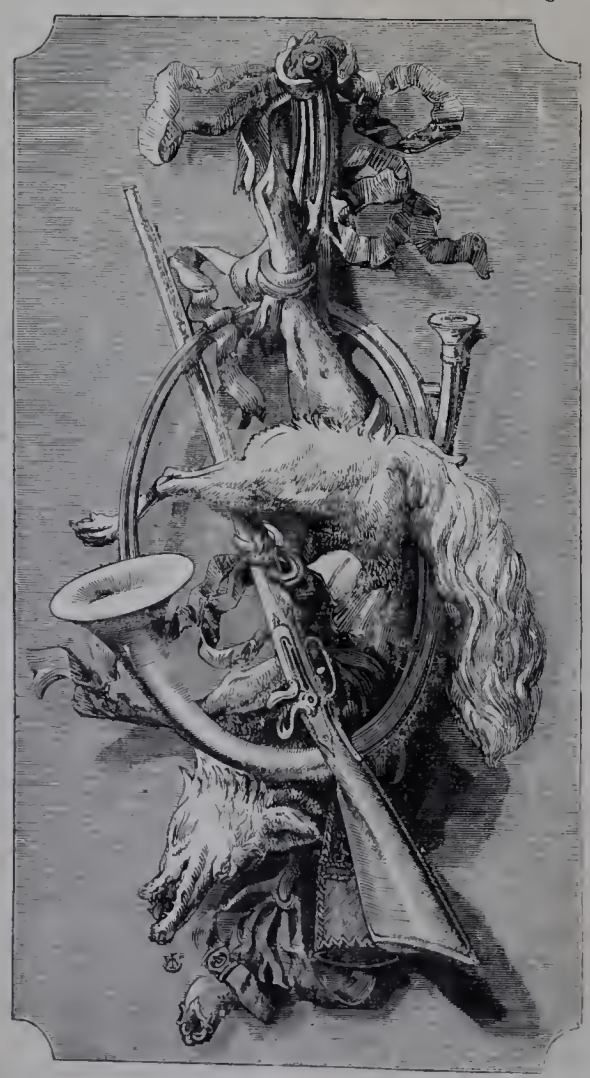
A piece of elaborately carved furniture—a Table— is contributed by John A. Clark, a designer of ornamental

furniture in Dublin. We do not care to see little images or tall and slender floral ornaments, however delicately carved, perched upon the legs of a table or elsewhere at-

tached when they have no constructive use. Decora- tions of this description are certainly not useful, and as certainly they are not in good taste.

England has long been famous for the beauty and perfection of the wood-carvings executed by her artists. The productions of Grinling Gibbons, who has been

justly called the English Cellini, still adorn the halls of Chatsworth, and receive the admiration of every visitor at that princely seat. In our own times the carvings of



Gibbons have been reproduced in all their luxuriant and graceful beauty by W. G. Rogers, of London. Who ever examines the contributions of Mr. Rogers at the New-York Exhibition, will feel to be true what Horace Walpole long ago said of Gibbons, that he "gave to wood the loose and airy lightness of flowers, and chained together the various productions of the elements with a free disorder, natural to each species." We have engraved upon this page four examples; Two Panels upon which bunches of flowers are carved, and another Panel, bearing the instruments and trophies of the chase. The fourth is a grotesque Mask, about which three youthful fauns are wreathing garlands of fruits and flowers. It is intended, we presume, as an architectural decoration for a theatre.

of the United States. This, and the Collar figured upon the adjoining page, are exhibited by the manufacturers, Messrs. John Higgins & Co., of New-York and Dublin.

The sewed muslin trade of Ireland has already become one of very great importance both in a commercial

peasantry. In this generous undertaking the late Lady Deane, and the wife of Sir Lucius O'Brien, were nobly conspicuous. The former organized a parish school of

The engraving which fills the remainder of this page represents a corner of an embroidered Handkerchief manufactured for Mrs. Pierce, the wife of the President

and philanthropic point of view. It was introduced into Ireland during the years of famine in 1846–7, as a means of giving employment and food to the helpless embroidery, and taught and superintended it herself. Lady O'Brien sent an agent to France and procured educated superintendents, under whose care the peasant-

women and children of counties Clare and Kerry were transformed into artistic laborers. The value of these embroideries is very great. The *London Times* estimates the amount paid for labor of this kind, in 1851, in the province of Ulster, at 3,000,000 of dollars. Messrs. Higgins, who began this trade in 1847 with a weekly outlay of £10, now employ 45 convent and 17 parish schools, each averging 150 scholars, with a total yearly outlay for wages of £40,000.

The design of the artist is drawn on stone, and then printed upon the unbleached muslin. The agent distributes the work to the schools, or to the cabins of

the work people, and through the same channel it is returned to the manufacturer. After bleaching, the embroideries are sent to the millinery department, where they are carefully selected and made up

The stately and imposing Book-case engraved here, was manufactured by Messrs. Bulkley & Herter, of New-York. Its construction and its carved ornaments are of unexceptionable excellence. The material is oak, and retains its native color. It contains a series of splendid books exhibited by Messrs. Putnam & Co.

will both lay
me down in
peace, and sleep: for
thou, LORD, only
makest me dwell in
safety.

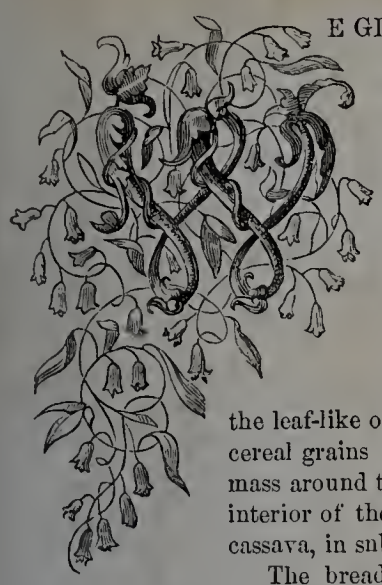
have mercy upon me, and
hear my prayer.

Ye sons of men,
how long will ye
turn my glory into shame?
how long will ye love van-
ity, and seek after leasing?

But know that
the LORD hath
set apart him that is godly
for himself: the LORD

We engrave two of the Compline Psalms, beautifully illuminated by a lady of this city, and exhibited by G. P. Putnam & Co.

RICE AND ITS CULTURE IN THE UNITED STATES.



E GIVE the name of *bread plants* to those which contain starch in sufficient abundance to constitute the food of man. It is the starch or fecula, that forms the principal mass of bread, and the essential part of it, although the gluten and albumen nsually fonnd with it, have au important part in the function of nutrition, especially in the formation of mnscle.

The particular part of the structure of bread-plants which produces starch, is widely different in their different tribes. Beans, peas, chestnnts, and their allies contain it in the cotyledons, the leaf-like organs which inclose the undeveloped germ. The cereal grains and bnckwheat yield starch iu the albuminous mass around the germ; some of the palms and eycads, in the interior of their stems; the potato, with the tropical yam and cassava, in snbterranean stems and roots.

The bread-plants are not universally and uniformly distributed the whole world over. Some are almost local in their *habitat*, but the most important, those which are hardiest and most prolific, have been carried from country to country, and are the commou property of all civilised nations. There are regions of the globe of continental extent, in which the sterile soil and rigorous climate forbid the cultivation of any bread-plant. Such is the character of Ieeland and Greenland, and of the northern part of America, extending on the eastern side down to the parallel of 50° N. L., and including also Newfoundlaud, which lies much further sonth than the fruitful plaius of Denmark. In Scandinavia, barley and potatoes are sparingly produeed within the sheltered fiords as high as the 70° N. L.; but on each side of this extreme and exceptional point, the line, north of which no bread-plant can be cultivated, sinks rapidly southward, and on the east excludes the greater part of Siberia, and almost the whole of Kamtschatka. That portion of the globe lying south of this imaginary line, may be divided into several zones and regions, each of which is characterized by one or more bread-plants of cnltivated or spontaneous growth. In the present paper we can speak of only one of the bread-plants, and of its culture as conducted in the United States.

Rice, in one or another of its very numerous varieties, is, or is expected to be, contribnted to the Exhibition from India, Egypt, Sardinia, Guiana, and Carolina, testifying to the value in which it is held by some portion of the family of man in eaeh of the great continental divisions of the globe. In India, the Eastern Archipelago, and the maritime districts of Chiua, rice affords to the dense popnlation often almost the sole support of life. A total failure of the crop would be a thonsand fold greater calamity than was the potato famine of Ireland; a bountiful harvest is the greatest of material blessings to these nations. From the scalding jungles of Ceylon, almost to the edge of the glaciers of the Himmalaya, where, in terraces on the mountain side, a variety of peculiar hardihood is cultivated, rice is the main object of agriculture, and from seed time, when, by a prescriptive right established by the practice of thousands of years, the farmer claims the assistance, not only of the artisans of the villages, but of their wives and children, until the ripe seed is beaten from its husk, it is watched over by the people of every rank, caste and profession, with a hopeful anxiety snch as honors no other grain. It is hardly less important as a source of nourishment to thousands of our race on the banks of the Nile and in large distriets of Central and Western Afriea; the Freneh are commeucing its culture in Algeria, while on the opposite shore of the Mediterranean, it is found heavily produetive upon the well-watered slopes of Sardinia, and in the southern marshes of nnfortunate Hungary. It holds its place with less importance among the luxuriant productious of South America, Mexico and the West Indies, but the beautiful samples sent to us from Demarara, indicate that it does not fail in excellence and productiveness when attention is there given to its eulture.

In the United States, althongh the cultivation of rice as a staple, is confined to the banks of the estuaries of a few small rivers in the States of North and South Carolina and Georgia, it is a crop of no insignificant national importance. In the year 1850, the value of riee exported amounted to $2,600,000, being more than one-third the valne of all the wheat and flour, more than five-ninths the value of Indian corn and meal, aud nearly one-sixth of the value of *all the vegetable food* exported.

Carolina rice is probably the best in the world, and is worth in London 18 shillings a ewt. where India riee is worth but 10 shillings. There is no point to which our planters pay more attention than to the choice of varieties, and the selection of seed, and to this is to be mainly attributed the gradual improvement which the grain has aequired in their hands. No doubt, also, something is due to a happy adaptation of soil and climate to its wants. It is a circumstance worthy of note, that both cotton and rice, each originating in India, and naturalized in our country, have here acquired an excellence of quality unequalled any where else in the world. We hail the omen! The culture of rice in the United States commenced almost by accident, a French ship from Madagascar, driven by stress of weather into the harbor of Charleston, having brought thither some rice "in the cook's bag," which was the first seed sowed. This was in 1694—and in 1707 (only thirteen years later) rice is mentioned in a pamphlet, published in London, first, in a list of the more important importations from the Colony of Carolina. In thirty years from its introduction, the annual export from the port of Charleston was nearly 20,000 casks. The expense of raising rice is mainly proportionate to the cost of the labor directly or indirectly expended npon it, and the value of labor in our Southern States is regulated by the demand for it in the production of cotton: as in supplying this most valuable material to the manufacturers of Europe and our own country, we come much less in competition with other producers than in supplying articles of food, rice can only be profitably cultivated for market under circumstances of extreme favor. But although thus restricted, the amount grown and exported has continued to increase, and the area of land devoted to the crop is being every year enlarged. We shall presently explain the peculiar natural advantages of the coast of Carolina, which enable labor to be there profitably applied to rice culture, notwithstanding the cotton monopoly.

The rice plant, *Oryza sativa*, is a panicled grass, having some resemblance to barley; it will grow in widely different soils and climates, rapidly changing its character, and reproducing itself in varieties adapted to the new conditions in which it may be placed. But it is naturally an aqnatic plant, and such varieties as are yet knowu to agriculture, are natives of the tropical regions, and to be very productive, require to be cultivated under great heat, and very abundantly supplied with moisture. In a temperate climate, therefore, and in ordinarily dry soils, although (up to a certain point) the grain improves in quality, its production is so small that its cultivation is less profitable than that of the cereals. The Exhibition contains samples of the "wild rice of Minnesota," a native variety evidently of considerable prodnctiveness as well as hardihood, which will form the subject of a separate article in the Record. It is extremely probable that this might be so improved by cultivation that it could be profitably produced in our Northern States. It would, without donbt, however, require to be freely irrigated to produce at all abundantly. There is said to be a variety of rice in Java and Sumatra, which yields a fair crop far up on the mountains, without a greater degree of moisture than is required for oats or other grains. Naturalists and travellers have expressed the opinion that this might be made a profitable subject of field culture in the ordinary agriculture of Europe; but we are aware of no trial having been made of it. Nor can the culture of any variety of rice known to the civilised world, be profitably undertaken, except in regions of almost tropical heat, and with the advantage of ready and most abundant means of irrigation with fresh water. Salt or brackish water is even more poisonous to the Rice plant than to most others. Let us now take a birdseye glance at the natural features of the coast of our Southern Atlantic States, and we shall see why rice culture is there made profitable, while it is not, extensively, any where else in North America.

Along the coast there extends a series of narrow sand-bars and islands, low and sterile; seldom inhabited, and when so, only by a few lazy, sottish Indians, half-breeds, negroes, and whites, who dwell in miserable shanties, supporting life by fishing, shooting and trapping. At a few prominent points, there are light-houses and life-boats, with other means provided by Government for relieving ships that may be driven near them in distress. Scattered far more frequently we may see the skeletons of many gallant barques, which, lifted high and thrown far up by great storm-tides, have been barred in and half covered with sand, as the victims of war are buried. Even now, when ships in the offing swing listless on the glassy sea, and drooping sails flap idly in the calm hush of a summer's twilight, the seaward shore is trembling under the heavy charge and repulse of surge and sand; black, cavernous walls of breakers sweep toward the beach, and with a low, sullen, unwavering, never-ending cadence burst upon it in broad, rushing belts of foam. There are shallow openings through which the waters ebb and flow; but the billows lose themselves, and the tidal currents steal along the inner shore with smooth and silent motion.

Crossing this sheltered lagoon we find sedge-banks and salt-grass meadows, with many creeks and brackish pools, and much debatable ground, miry and rush bearing. On the higher parts there are dense thickets of cane, palmetto, and other low trees and shrubs, and multitudes of birds and animals here make their nests and lairs. Farther from the sea, and as the water becomes less salt from the flow of streams from the upland, the low grounds also, though submerged by every rising tide, send up strong shafted cypress trees, and are shaded under their dense, though light and feathery foliage. Frequent sluggish creeks meander through this shoreland region, and many rivers that rise far away in the mountains, here lose themselves, becoming dead and currentless, as the lagoon water rises under the silent, but resistless influence of the semidiurnal throb of the ocean. Their broad, low borders are thus twice each day flowed over, and the soil kept wet and spongy.

Elevated ridges of sandy land, bearing forests of glistening pine and glossy magnolia, sometimes add diversity to these swamps. Heavy rains frequently

swell the rivers, and the torrents of their flood being at length conquered by the tide, the eddying currents deposit at the base of these sandy ridges the rich freight they have brought from the calcareous or granitic and aluminous soils of the distant mountains in which they rise, with the organic waste of the great deciduous forests through which they flow; silicious particles are again washed down from these, and with all is mingled the rich silt of the lagoon bottom, brought up by the turbid tide during extraordinary storms of the ocean. Such is the soil which has been gradually forming until it is of great depth, now overgrown with an almost impenetrable forest, and thicket of underwood and rushes, which is chosen to be transformed into a rice plantation. It is at such a distance from the sea, that there is no taste of salt in the water by the tidal rise of which it is twice a day submerged to a depth of from one to three feet and alternately left bare.

The shape and extent of the proposed rice ground having been determined on, the trees are felled and the surface cleared for a space of fifty feet all around it. On the inside of this belt, a ditch is now dug eight or ten feet wide and five deep, the earth excavated from which, serves to form an embankment about midway between it and the river. This embankment must be high enough and strong enough to withstand the pressure of the strongest flood, and if the ditch does not afford material enough to make it so, earth is obtained from the edge of the river, a large margin beyond its outer base line being left for this purpose and to the security of its foundation. At the commencement of this work, of course nothing can be done except for a few hours at a time after the tide has partially ebbed, but it does not take long to throw up a slight intrenchment which is sufficient to resist its ordinary flood. As soon as this is finished, gates are formed which allow the outward flow of the water within the embankment, but prevent its return. The labor is then continued without interruption. As soon as the main embankment is completed, the work of clearing the land commences; the trees are felled and rolled into long rows, mingled with the brushwood and rushes. This being done, the inclosure is subdivided into fields of convenient size by smaller embankments and ditches, each of which has a separate communication with the river by means of a strong trunk provided with two gates, by which the passage of water in either direction may be permitted or prevented. As soon as the log heaps are sufficiently dry, they are set fire to, and as much as possible consumed. Then the negroes go all over the inclosed ground, "chopping" and turning over the surface as well as they can with rude heavy hoes; the cypress stumps are much too strong and numerous to admit the use of any of the more usual instruments of tillage. In the spring it is sown with rice.

As the soil dries and the vegetable matter in it decays under the influence of air and heat, it diminishes in bulk, and the surface becoming lower, it is less completely drained, and many minor ditches have to be dug, until, when in a few years the ground has become compact and stable, each field is divided into a number of parallelograms of perhaps a quarter of an acre each. The new rice plantation does not offer a very pleasing landscape to the eye, the ground being closely studded with stumps and encumbered with half charred logs: let us leave it and visit an old family plantation, such as a gentleman whom you may have met in summer, at Saratoga or Baden Baden, will drive you out to, if you have the good fortune to fall in with him again, in Charleston or Savannah, during the winter. It was his great-grandfather that had the work done that we have thus far examined.

You are drawn rapidly by a fine pair of horses over deep and trying sandy roads through the midst of a dense pine forest, until you reach a simple gateway and ledge; the latter occupied by a crippled negro, unfit for field-work, who opens the gate for you. You enter and are at the head of your friend's plantation; it is yet, however, nearly three miles to the river on which the rice fields are situated, about two-thirds of the 3000 acres which it contains being sandy upland, covered mainly with pine wood. Soon after passing the gate, there is a clearing of a quarter of an acre, on which is a small cottage, with two log cabins, a log stable, a small garden, and a dozen or two peach and fig trees near it. An old negro lives in one of the cabins, the other dwellings are unoccupied. The "summer-house," our friend calls it. His overseer's family reside here in summer, and he has a room that he can occupy himself, in case he should have to spend a night on the plantation during the heat of summer; for then it is almost certain death for a white man who has not been born and brought up subject to the miasm of the rice fields, to sleep adjacent to them. This "summer house" is so far removed from them, and there is so much pine wood to intercept the malaria, that it is quite safe for the overseer who spends the day superintending the labor of the negroes on the flooded land, to remain in it at night. The negroes, although they are considered malaria-proof, are less healthy than on the cotton plantations; the mortality among the children, especially, is greater. They formerly were obliged to spend the night in close proximity to the rice fields, but recently new cabins for them have been built back a little distance in the woods, and a marked improvement in their general health has been found to result from this removal. Following the crooked road through the woods a mile or two further, we at length drive through their settlement, as it is here called; the cabins are in two rows, some sixty yards apart, with an avenue of trees between. They are of wood, whitewashed, and elevated on posts about two feet from the ground. This is to remove them from the moisture of the earth and to insure ventilation, or at least, the floors not being tight, to prevent the accumulation of carbonic acid gas within them, the negroes being too much accustomed, when they come in from their work at night, to shut themselves up closely in their cabins, and, leaving great wood fires to smoulder on the hearth, to go to sleep upon the floor.

There is one cabin provided with a verandah, which is kept for a hospital, and another for a nursery for the negro babies, where they are taken care of by an old nurse, their mothers not being allowed to take them with them when they go to perform their tasks in the rice fields. Children always seem to suffer more from malaria than grown people. At the lower end of the settlement is the overseer's ordinary residence, a neat white cottage, with a garden and a small cabin or two, used by his domestic servants, behind it.

We now enter a really noble avenue of live-oaks and other smooth-leafed evergreens, of great size and curiously hung with waving streamers of Spanish moss; driving for a quarter of a mile through it upon an elevated, dry and well kept road, we approach our friend's country mansion, sooth to say a rather paltry house it is to be approached in this manner, built of wood, painted white, and of very slight construction. Before it there are planted oranges, camellias, and other plants that Northerners are accustomed to consider exotics; on one side there is a large court, around which are numerous offices, the kitchen detached from the house, the lodgings for the domestic servants, kennels for dogs, &c.; and beyond a range of stables. On the opposite side of the house is a fruit and vegetable garden, and on the fourth side is a broad open space (it would be a lawn if it did not lack the essential, close, firm green-sward), with a few fine spreading trees upon it. The trunks are three feet in diameter, and you will be surprised, probably, to learn that they were planted only thirty years ago—so rapid is the growth, stimulated by the hot, moist atmosphere which they here enjoy during the greater part of the year. You may observe, also, that the orange and lemon trees have fruit upon them, the camellia japonicas are of fine size and in profuse bloom; they would, however, have suffered, and possibly been killed, if they had not received some slight protection during the coldest nights of the winter. It is just the climate in which rice of superior quality will produce most abundantly.

From the elevated verandah of the house, you may now look across the *quasi* lawn, at the end of which there is a sudden depression of the surface of the ground, and beyond it a landscape that would delight a Hollander. At first sight it seems almost interminable dead flat surface, with a crooked river, and a few narrow canals crossing it, some hedgerows along their banks, and a few isolated trees. Look closely and you may observe that there is a strong *levee*, or embankment all along the river side, and smaller walls of earth cross the flat ground running at right angles to this and to each other. That is the rice land, now entirely free from stumps and logs, dry and smooth, and with no sign of the old swamp and forest, except in some neglected corner or point outside the river wall. There are several thousand acres of rice land under your eye, but it is generally owned in parcels of less than one thousand, and when of the best quality and thus highly improved, its value is from $150 to $200 an acre; the amount of upland, the condition of the adjoining woodland, the distance from the city, the value of the mansion and grounds about it, the character and health of the negroes, which would ordinarily be transferred with it, and other circumstances affecting its desirableness as a place of residence in the winter, such as the abundance of game in the adjacent forest and waters, all having an influence upon its market value. If you undertake to purchase a plantation, it is very improbable that the proprietor will be able to show you that he has been clearing ten per cent. per annum on the price he asks you for it. There are certain luxuries to be had upon an old rice plantation, and a certain dignity and repute connected with the possession of it, that rich people are often willing to pay handsomely for.

Our friend has nearly one thousand acres of rice land, and between two and three hundred negroes. So many of these, however, are women and children, and infirm or weakly, that he will tell you that his force is not equal to much more than one hundred strong men—or what a slave-dealer terms "*prime* field-hands."

After you have feasted, and slept, and hunted, and otherwise enjoyed the good cheer and generous hospitality of our planter, he may take you to the rice fields and satisfy your curiosity with regard to their management. We walk toward the river (suppose it to be the latter part of March), and just at the foot of the sandy upland (which was the bank of the old swamp), we come upon a canal some twenty feet wide, running all along the inner edge of the flat rice ground. This brings water for flowing the inner fields; the swamp was so wide it was not convenient to arrange all the fields so as to flow them directly from the river. It also serves to take the crop from the outer fields to the barn, and to send it again down to the river, after it has been threshed and cleaned, to be shipped by the schooners to the city. Three large scows are kept on the plantation for this purpose.

We cross the canal on a bridge, at the end of which is a trunk like the flume of a grist mill, except that it is covered over, and its mouth on the inside is at the bottom of a ditch, now nearly dry, which runs all around a field of some twenty

acres: outside of the ditch is an earth wall, which here, where it forms the side of the canal, is four or five yards across, but on the other sides is not more than two or three yards thick at the bottom and one on the top. In the trunk there are two gates, with rachet work and levers for adjusting them at the top. The field is further divided, as has been described, by minor ditches into quarter-acre plots. You may find here a crop of oats just springing through the ground, for, notwithstanding the exceedingly great original fertility of this swamp-land, and the continual addition of fertile material, which it doubtless receives from the water with which it is irrigated, it is found that it will not bear heavy crops of rice for ever, and that it increases the subsequent product very much if other crops are occasionally introduced, particularly if manure is added with them, or if they are themselves of a character to increase the fertility of the soil. The cow-pea is frequently used for this purpose; the whole crop, when it has ripened, being ploughed in, or fed off on the land. Corn, oats, and sea-island cotton, are also sometimes cultivated very profitably upon rice ground. Oats, when sowed upon rice ground, are sometimes flowed. This operation tends to produce a very rank growth of straw, and as the crop is used like hay, to be fed to horses without threshing, in a dry season it is of considerable advantage to it.

By walking along the top of the cross embankments you come to the outer fields, in one of which you find fifty negroes, men and women, at work, and in the other some half dozen. Between the two is the overseer. He walks to the outer, or river-side embankment, and by his shouts seems to be hastening the half dozen hands in the field on your right. This, if you look closely, you will see is covered, in each of its plots, with parallel lines of shallow trenches or drills, in which rice in the hull has been thickly scattered. In the field on the left the hands are making these trenches with narrow hoes; they are thirteen inches apart, two inches deep, and four wide. Those in the right-hand field are sowing the seed in the last square, which they do by quick throws of the hands with great expertness.

We walk on till we come to where the overseer is standing. He tells the planter that he has hoisted the gate and the tide will be flowing in before the sowing is well done. But how is this? you inquire. Is the water to be let on to the field before the seed is covered? Yes, examine the seed and you will see that there is a slight coating of clay upon it, scarcely perceptible: it has been prepared by washing in water in which clay has been stirred, and this is sufficient to keep it in its place, when the water from the river shall flow over it, as you shall presently see; for now the water coming in at the gate as the tide rises, first fills then overflows the ditches, and now as the sowers have all completed their work and leave the field, it steals along the drills and at length begins to cover the surface. Some straw, leaves and stubble, rise upon the water and drift with the wind toward the river embankment. When it has all reached there, it will be raked out, thrown into heaps, and as soon as again dry, burned, to destroy any seeds that may be in it.

As soon as all the elevated parts of the field (for the water shows that its surface is not a perfect plane) are covered, the overseer shuts down the gate. In a few days, if the weather is warm, the seed will sprout under the water. It is an advantage of the mode of planting called planting in the open trench, that if cool weather should occur for some time after planting, the seed is much less liable to rot and be lost than when it has been first covered with earth. In the latter case, seed is not clayed, and is lightly covered by raking earth over it: water is then let on as open-trench planting. Why the seed should be more liable to rot in one case than the other is not known, perhaps light has the effect to retard rapid decomposition.

When the seed has been first covered with soil, as soon as it is seen to have sprouted, the water is drawn off, but on the open-trench plan it is left on until two leaves are developed, which will perhaps be in a fortnight after our visit.

Turning now to the field on the other side of the trench, you perceive that all hands are engaged in opening trenches or seed-drills. They will not commence planting this field until to-morrow, or until they are sure they will be able to finish it before the following rise of tide, so that the seed may be immediately protected from birds by flowing it.

Walking round the outside of the field you find several men filling up a trench that they had opened directly across the main embankment. An alligator had burrowed under it so that it leaked, and to fill his hole completely and securely it was necessary to open a trench to it from the top.

Constant attention is required to keep the embankments in order. Sometimes when there is a bad breach, such as a severe storm coincident with a flood of the river might have made in this place, it is necessary to bring earth from the upland to fill it up.

As you walk back towards the barn, you inquire about the subsequent culture of the rice, and are informed that soon after the water is drawn off, the whole field will be hoed between the trenches to destroy the weeds, and two or three weeks later will be hoed again, the water seldom being admitted during this time, unless for a single tide to soften the earth if it should get very dry or hard. After the second hoeing the field is flowed again so as almost to cover the rice generally over the field, the rice being probably eight or ten inches high at the time. The water is left on for perhaps two weeks; it depends on the appearance of the plants, sometimes longer, sometimes a shorter time. Soon after it is drawn off, the rice is twice hoed again as before; then the water is let on again, and is now kept on until harvest, being gradually raised as the rice grows higher, so that over as large an extent of it as possible only the heads of rice shall appear above. In general terms it may be said that the rice is kept in water (the tops of the plants appearing always above it) as much as possible from the day it is sowed until it is ripe, so far as it can be, and give opportunity for keeping it clean of weeds. Some planters keep the water on more than those who follow the plan we have described, and the negroes are often sent in to pull the weeds by hand when the water is a foot deep on the ground. One objection to retaining the water so constantly upon the field is that the crop is more liable to be injured by a small white worm, to the attacks of which it is always more or less subject. Those who always give the crop four dry hoeings, also think that the laborers suffer more in health when they are obliged to work much in the water. Others contend that they suffer less because the labor is lighter. Under every plan it is usual at some time during the last or "lay by" flow to lower the water to the depth of, at most, a foot, and send in the negroes to collect weeds growing in the drills with the rice, these not being all eradicated in the hoeings.

As soon as the rice is judged to be sufficiently matured for its harvest to commence, the water is drawn off, and immediately, even while the water is still some inches deep, the negroes commence to reap it with sickles. It is cut off at about a foot from the root, and the reaped rice is laid in handfuls, as it is cut, on the top of the stubble, so that it will be supported above the mud and dry quickly. Usually it is dry enough to bind in twenty-four hours after it is cut, when it is tied in small sheaves and immediately transported on the heads of the laborers, either directly to the stack yard or to the scows by which it is boated through the canal. It is then laid up in neat round stacks, which are thatched so as to keep it dry and in good order until it can be threshed. The usual crop from an acre is from thirty to sixty bushels. By resting the land, or introducing a dry culture crop, particularly if this is manured, or is itself a manuring crop, a still larger crop of rice may be afterwards obtained—even 100 bushels.

Rice is threshed by machinery precisely similar to that used for other grain at the North and in England. On the larger plantations steam is employed to drive it. After threshing, the grain of rice is still enveloped in a close, hard, brown husk. In this condition it is known as *paddy*, or rough rice, and as when thus protected it is less liable to injury from dampness or atmospheric changes, it is usually exported with the husk remaining on. There are mills for removing it in most of the large commercial ports of the Northern States and of Europe. In many of the latter, discriminating duties in favor of rough rice are laid to favor this business. The husk is cracked by slightly pounding the grain, and subsequently removed by riddling. The rice is afterwards sorted into a number of different classes according to size, the largest and fullest grains, called "head rice," being considered the best, and the broken and smaller less valuable. The best rice before leaving the rice-mill is subjected to an ingenious process, by which it receives a high polish, and is thus presented to the consumer with a very clear and beautiful appearance. Some very handsome rice (for a European production) grown on the estate of the Marquis Tornielli, in Sardinia, will attract attention in the Italian department of the Exhibition. It is prepared by a new process, the invention of Signor Uglietta, of Novara.

FOLIACEOUS FIBRES OF AMERICAN ENDOGENOUS PLANTS.

AMONG the elements of future wealth in the United States, we call the attention of our readers to the resources which lie undeveloped in the foliaceous fibres of the endogenous plants, that are native to this country or may be grown here. A fine collection of fibres derived from plants of this character, may be seen in the Exhibition among the contributions of British Guiana, and of Hayti. The specimens consist of fibres in several stages of preparation, and of the articles manufactured from them.

All vegetable fibres used for textile purposes may be classified into three great divisions; cortical fibres, of which flax and hemp are familiar examples; capsular fibres, like cotton; and foliaceous fibres, which are illustrated by the examples already mentioned, and by Manilla hemp, silk grass, &c. The stems of the plants producing cortical fibres consist essentially of a woody core, surrounded by a sheath of fibrous texture, and the two are connected together by a peculiar vegetable glue, which unites them into one solid stem. In the preparation of flax and hemp, the object in view is to remove this matter, and thus bring about the separation of the useless stem from the valuable external sheathing of fibres. Capsular fibres, as the name indicates, are obtained from pods or capsules. Cotton, the type of this class, is found in the capsules of the Gossypium, enveloping the seeds and closely adhering to them. The fibres of cotton are always short, soft, and of a white or yellow color; under the microscope they present the appearance of a flattened ribbon, which is at the same time tubular. Foliaceous fibres are obtained from green living leaves, the produce of *endogenous* plants;

these leaves are distinguished by having their veins in all cases parallel to one another, and also longitudinal.

All flowering plants are divided into two great classes, called by botanists *Exogens* and *Endogens*, which are distinguished from each other by their structure, appearance, and to some extent, by their geographical distribution. The former, constituting by far the largest part of the vegetable kingdom, present the aspect and structure, which are familiar in all the trees and shrubs of temperate regions. The stems of Exogens are made up of a central pith, surrounded by concentric zones of wood, one of which is added on the exterior each year, and an external bark which covers and protects the whole. The veins of their leaves form a net-work, and are articulated to the stem; and their floral organs are normally arranged in fives. Endogenous plants attain noble arborescent forms only in tropical climates. The tulips of our gardens, the cereal grasses, the maize and the sugar cane belong to this class. Their stems present no distinction of central pith, or woody circles, or separable bark; but the woody fibres produced in the leaves run towards the centre of the stem, and finally curve outward to terminate in the exterior rind. The wood is hardest and most compact at the circumference. Their leaves always have straight and parallel veins, and are adherent to the stalk; and the parts of the flowers are arranged normally in threes or multiples of that number. It is only in tropical and subtropical regions that endogenous plants attain any very great development, or yield fibres suitable for textile purposes. To an inhabitant of the northern temperate zone an endogenous plant whose green leaves yield valuable fibres, is a curiosity only to be seen in conservatories and botanical gardens.

Six orders of Endogens yield foliaceous fibres which are commercially valuable.

The Liliaceae, or *Lily Tribe.*—The species of this tribe are widely scattered over the world. They are, however, much more abundant in the temperate zone than in tropical regions, where they exist chiefly in an arborescent state. This order includes the different species of Aloes, the Yucca of the Southern States, and the Phormium Tenax, or Flax Lily of New Zealand. The Aloes are found mostly in Africa; one species is, however, a native of the West Indies, and two or three are indigenous to the Arabian Peninsula and Southern Asia. A species of Aloe found at the Canary Islands, the *A. Dracaenas*, is described as from seventy to eighty feet in height, with a diameter at the base of sixteen feet.

In the East Indies Liliaceous Plants are rare. In New Holland and New Zealand they form a distinctly marked feature of the vegetation. In countries where the woody and prickly species of aloes abound, they are often planted as hedges; some species are often described by travellers as the Agave, or Bromelia, which they resemble in a degree. Of the Yucca, which belongs to this order, there are at least five species indigenous to the United States, flourishing naturally upon the poorest soils, from the Potomac to Texas. Their botanical names are *Yucca filamentosa*, *Y. gloriosa*, *Y. aloifolia*, *Y. angustifolia*, and *Y. recurvifolia*. The common names and synonymes for the *Y. filamentosa*, are bear grass, silk grass, Eve's thread, and everlasting. The *Y. gloriosa* is known as the Spanish bayonet, Adam's needle, Petre and Dwarf Palmetto. All the species afford an abundance of the strongest, fibres, from six inches to two feet in length. Of the *Y. filamentosa*, Elliot in his Botany of South Carolina says, "it appears to possess the strongest fibres of any vegetable whatever, and if it can be raised with facility will furnish a valuable article in domestic economy." The Phormium Tenax, or New Zealand Flax Lily, was discovered during the voyage of Captain Cook, and was introduced into Europe in 1791 by the French Botanist, Labillardiere. It has become acclimated, and flourishes well in the South of France, and also in Algeria. It furnishes a beautifully strong, fine fibre, which is used to some considerable extent. This plant has also been introduced into South Carolina, and other Southern States, where it flourishes and propagates itself in a wild state.

Bromeliaceae, or *Pine Apple Tribe.*—These are all, without exception, natives of the continent and islands of America, from whence they have migrated in such numbers, that they now constitute a part of the flora of the west coast of Africa, and some parts of the East Indies. The leaves of the common pine apple, with whose fruit every one is so familiar, furnish fibres from which very fine muslin has been manufactured.

Amaryllidaceæ.—It is from the agaves of this order that the best known foliaceous fibres are produced. The leaves are thick, pulpy, and of a greenish gray color. Their length varies from one to fifteen or twenty feet, and the fibres which are obtained from them by simple scraping, in the manner hereafter described, are proportionally long. The species producing the well known Sisal Hemp, and other varieties, are known as the Agave Sisalana, Agave Americana, the Henequen de Sosquil of Yucatan, the Ixtla of Goazalcoalcos, the Yashqui, Sacqui, and the Pita. Several of these species were introduced into the United States in 1837, and have since become naturalized. Leaves have been exhibited at the north during the past year, cut on one of the Florida Keys, over ten feet in length, and yielding fibres far superior to the so-called Manilla Hemp.

Pandaceæ, or *Screw Pine Tribe.*—Plants of this order are extremely abundant on the coral islands of the South Pacific and the Indian Archipelago, and also upon the Isle of France. In America they are rare. The Pandanus grows naturally upon arid, sandy, or rocky soils, and from the upper part of the stems shoot out numerous aerial roots, which burying themselves in the soil, serve as stays or braces, and prevent the plant from being uprooted by the winds. The leaves of all this species are fibrous, and in the South Pacific furnish almost the only material for bagging, cordage, mats, baskets, hats, and clothing. The fibres are generally white, smooth and lustrous, all the species are easily propagated, and their natural habitat appears to be those sterile arid districts of the tropics, which are unfit for any other useful vegetation.

Musaceæ, or *Banana Tribe.*—The gigantic leaves of the plants of this order have parallel longitudinal fibres, which start from the point of the leaf, and running between thin laminæ of green cellular matter, are gathered up to form the stalk, or petiole which sustains the leaf. The Bananas are found in their greatest perfection at the Cape of Good Hope, in the Indian Archipelago, and in British Guiana, and some of the West India Islands. One species is now naturalized in Louisiana; another is cultivated with success in Europe as high as 33° or 34 N. L. In their habits of growth, they generally prefer humid, or marshy soils, deep ravines, and moist forests; one species is of a hardy nature, and prefers a mountainous and elevated locality. The fibre exported in such large quantities from the Philippino Islands, under the name of Manilla Hemp, is obtained from plants of this order, *Musa paradisiaea and M. textilis.* Specimens of the fibres of the plantain are exhibited among the collections from British Guiana.

Palmaceæ, or *Palms.*—The plants of this order furnish the noblest and most characteristic vegetation of tropical countries, and yield products most useful and necessary to man. Among these diversified products are, flour, starch, yeast, sugar, wine, alcohol, oil, wax, resins, milk, butter, vinegar, fruit, and medicines; household utensils and building materials, cordage and thread, paper and cloth, weapons, and habitations. One species, the *Areca eatechu*, furnishes the betel-nut; another, the *Borasus flabelliformis*, yields the arrack of the East Indies; the *Cocos nucifera* is the cocoa-nut palm, and supplies also the strong supple fibres known as *coir*, of which when the Dutch were in possession of Ceylon, 3,000,000 lbs. weight were annually manufactured. The American species of palm, which are especially valuable for affording a supply of superior fibre, are the Ticu Palm of the Brazils, the Morriche Palm of the delta of the Oronoco, and the Gomuty Palm of the West Indies.

Plants of the above described orders, sustain the same relation in respect to fibre, to southern and sub-tropical climates, that the flax and hemp bear to the northern and temperate zones. In other respects the endogenous fibrous plants are also of great value and utility. Clavigero, in his work on Mexico, speaking of the Agave (pita, or maguey), says—"Some species furnish protecting inclosures, and afford impassable hedges to other objects of cultivation. From the juice of others are extracted honey, sugar, vinegar, *pulque*, and ardent spirits. From the trunk and thickest portion of the leaves roasted in the earth, an agreeable food is obtained. The stalks serve as beams, and the leaves as roofs for houses. The thorns answer for lancets, awls, needles, arrow-heads, and other cutting and penetrating instruments. But the fibrous substance of the leaves is the most important gift of the agave genus to Mexico. According to the species, the fibre varies in quality from the coarsest hemp to the finest flax, and may be employed as a superior substitute for both. From it, the ancient Mexicans fabricated their thread and cordage, mats and bagging, shoes and clothing, and webs, equivalent to cambric and canvas; the hammocks in which they are born, repose and die; the paper on which they painted their histories, and with which they adorned and adored their gods. The value of the agaves is enhanced by their indifference to soil, climate and season; by the simplicity of their cultivation, and by the facility of extracting and preparing their products. It is not, therefore, surprising that the ancient Mexicans used some part or preparation of their plants in their civil, military and religious ceremonies, at marriages and deaths, nor that they perpetuated an allusion to their properties in the name of their capital."

Humboldt, Hernandez, Warden, and Poinsett, all unite in bearing similar testimony to the value of the Mexican agave.

The foliaceous fibres of American production, best known in commerce, are those produced in the vicinity of Merida, in Yucatan, and exported under the general name of Sisal Hemp. The bales of this hemp, as they come into our markets, generally contain fibres of very different materials, but the greater part are the produce of the plants known as the pita, or ixlta, and the sosquil, the henequen or the jenequen. The pita grows wild in forests, and furnishes extremely fine and strong fibres which can be used for sewing thread. The sosquil, or henequen, on the contrary, grows in the sun spontaneously throughout the whole of Yucatan, in the most sterile and arid places; it is also cultivated and yields a coarse fibre greatly resembling Manilla hemp. The method of cultivation and preparation followed in Yucatan for producing the "Sisal Hemp," is as follows: the young plants are placed about twelve Spanish feet apart, a stony or sandy location being preferred. During the first two years some labor is required to destroy the weeds between them. The shoots, when transplanted, should be about three feet high, and are ready to yield two years afterwards. The third year the cutting of the lower rows of leaves is commenced, and every four months the operation is repeated. Each robust plant is capable of yielding not less than twenty-five, or more than one hundred leaves annually, and will continue to produce in like

manner from five to ten years in succession. Seventy-five ordinary leaves are estimated to yield seven and a half pounds of fibre; the most productive leaves being those of the fourth cutting. At intervals of two years, shoots are thrown out from the roots, from five to ten in number, in a state to be transplanted; these are removed, with a single exception, to form new plantations, and the parent plant is also cut down when the shoot left has grown sufficiently to supply its place. If the original plant is suffered to grow, it eventually shoots up into gigantic flower stalks, from twenty to thirty feet in height, with its superior extremity covered with innumerable little plants, which have received the name of *hene quencitos*. The hardiness of the young shoots may be inferred from the fact that when cut from the parent they are exposed to the sun for fifteen or twenty days to "cicatrize their wounds," as a necessary preparation for replanting. "The simplicity of their cultivation," says a writer on this subject in 1838, "may be conceived from the statement, that there is not a hoe, nor a spade, nor a harrow, nor a plough, employed in the agriculture of all Yucatan."

The instruments and the method used by the natives of Yucatan for extracting the fibres from the leaves, are of the rudest description. A triangular strip of hard wood, with sharp edges from eight to twelve inches long, and from one to three inches thick, is with them an equivalent to the shaving-knife of the curriers, by which they scrape away from each side of the leaf on a board resting against the breast, the cuticle and pulpy substance that covers the fibres. Another mode of accomplishing the same object is, by pressing the sharp semi-lunar extremity of a long flat stick against any fixed surface upon a narrow longitudinal strip of the leaf, which is then drawn through by the unemployed hand. The length, weight, strength, and other qualities of the fibres, as well as the labor of separating them, vary with the magnitude, age, and position of the leaves. The fibres, after being freed from the investing pulpy matter, are washed and dried in the sun, which thus completes the labor of preparation, and the Sisal hemp is then ready for exportation or manufacture.

Concerning the amount of Sisal hemp exported from Mexico and Central America, we have no precise data. According to some statistics of the department of Vera Cruz, published at Jalapa, in 1831, the amount of fibre extracted from the Pita, and exported in 1830 from the port of Goazacoalcos alone, was 188,600 pounds. Large quantities of Sisal hemp are also exported every year to Cuba, and manufactured into coffee bags. The fibre which it most closely resembles, is the well-known "Manilla hemp," to which it is every way equal as regards strength and appearance, and in the opinion of some judges, the best qualities of Sisal hemp are superior to the Manilla. The importations of Manilla hemp into the United States are very large, with a constant yearly increase. The number of bales imported into Boston in 1849 was 31,271; with an average weight of 300 lbs. per bale, we have a total of 9,381,300 lbs. All this large amount of fibre might have been furnished equally well by the fibrous endogenous plants of America and of the United States, had this business received an equal amount of care and attention. It must especially be remembered, that the Manilla hemp is not, as its name would indicate, a true hemp, the production of the genus *Cannabis*, but is a true foliaceous fibre, derived from the stalk and leaves of an endogenous plant, allied to the plants producing the Sisal hemp, viz., from the *Musa textilis*, and *paradisaica* varieties of the *Musaceæ*, or Banana tribe. The processes for the extraction and cleansing of the Manilla fibres are very similar to those described above, as followed by the natives of Yucatan, for the preparation of the Sisal hemp. The vegetable tissues enclosing the fibres are scraped off by means of wooden instruments, and the fibres subsequently washed and dried. Other methods, followed to some extent, are to macerate the leaves in water, or expose them to the influence of the air in humid places, in the shade, until the investing cellular substance is destroyed.

With this reference to the value and method of producing the Sisal hemp and Manilla fibres, let us ask the question—In what manner can the endogenous plants yielding foliaceous fibres become subservient as sources of future wealth to the United States? The question may be answered as follows: Southern and Central America, with the adjacent islands, is the natural *habitat* of a great majority of the orders and species of endogenous plants, which yield valuable fibres. We have here the Agaves, the Palms, the Bananas, the Pine Apple, and the Yuccas. They are all hardy, productive, perennial plants, which propagate themselves spontaneously upon the worst natural soil, and become infinitely productive when aided by the least skill, care, or labor of man. All of them can be gradually acclimated and profitably propagated in the most sterile districts of the Southern States. Their introduction and cultivation will be equivalent therefore to the direct addition of absolute fertility to the most sandy, sterile, and worn-out districts; and we run no risk in the assertion, that foliaceous fibres may be more profitably produced on the poor lands of Georgia, Florida, and the Carolinas, than cortical and capsular fibres can be in the virgin loams of Ohio and Mississippi. As regards their introduction, the work is already accomplished, and the experiment tried. Some of the fibrous-leaved plants are natives, and are found as far north as Virginia, as the five species of Yucca, and some varieties of the Agave (*Agave Virginica*), Palm and Banana; others have been brought from abroad, and are now acclimated, as the *Phormium Tenax*, or New Zealand Flax Lily, which now grows spontaneously in various parts of the South.

And here let us notice the most important step which has thus far been taken in regard to this matter, and at the same time do honor to the memory of a wise, sagacious, patriotic man, who sacrificed his life in the attempt to confer a great national benefit upon his country; we refer to the late Dr. Henry Perrine. This gentleman, in the course of a long residence as United States Consul in the State of Tobasco, and at Campeachy, became thoroughly acquainted with the several varieties of fibrous-leaved plants growing in these districts, together with their manner of growth, cultivation, and the means employed for the extraction and preparation of the fibres; being impressed also with the great importance and benefit of introducing these plants into the United States, and having satisfied himself of the practicability of the enterprise, Dr. Perrine in 1837 petitioned Congress to aid in carrying out the attempt upon an extensive scale. The subject was referred to the Committee on Agriculture, who reported a bill granting to Dr. Perrine and his associates under the name of the "Tropical Plant Company," the pre-emption rights to thirty-six sections of land, situated in East Florida, below the parallel of 26 N. L. The bill received the almost unanimous consent of Congress, and Dr. Perrine immediately entered upon the work. A small plantation was formed at Cape Florida and other points in the vicinity, and a variety of plants brought from Central America were introduced. Among these were three or four species of the Agave, including the varieties producing the Sisal hemp, the Pulque Agave, the Cochineal Cactus, the Arnotto plant, the Date palm, Paper Mulberry, and Tumeric. All these succeeded well, and every thing at the inception promised the happiest results, when the hostilities of the Indians, consequent to the Seminole war, compelled the abandonment of the plantations. Dr. Perrine, however, whose whole soul was devoted to the enterprise, returned after an interval, and was subsequently killed by the savages in the vicinity. Since this period we do not understand that any further attempts have been made to carry out the enterprise. The plants, although neglected, have flourished, and propagated themselves extensively. The agaves, especially, have become disseminated throughout the whole of the neighboring country, and on some of the islands in the vicinity of Key West they may be found in great luxuriance.

The first great step, therefore, the introduction of the plants into the United States has been accomplished successfully; and the field is now open for further efforts, which, if properly made, must be crowned with success.

One great difficulty experienced in Yucatan, has been the want of a proper machine for suitably cleaning out the fibres from their enveloping vegetable tissues; the rude method followed by the natives being too slow and expensive. An Indian with his sharp stick only, and indolent habits, will generally clean from four to eight pounds per diem. A few years since a machine was invented in Massachusetts for the purpose of cleaning the fibres, and sent out to Merida by a Boston firm having large commercial dealings at that port. The machine is understood to have worked well, but the vegetable acid generated by the fermentation of the expressed juice of the leaves, corroded the metallic parts of the machine it was brought in contact with, to such an extent as to render them useless. The plan was consequently abandoned. Within the past year a chemical process has been discovered, which dissolves the green fleshy part of the leaves, while the fibres remain intact, and after washing are ready for use. This process, which is exceedingly cheap and simple, is controlled by a Massachusetts company who intend to put it into operation.

The introduction of the fibrous-leaved plants into the Southern States, from their adaption to sterile soils, ease of cultivation, abundant reproduction, and long duration, must prove of incalculable importance. With the fibres of one exotic vegetable the Southern States are now supplying materials for the clothing of a large proportion of the human family; with the fibres of other exotic plants they may hereafter supply materials for thread, twine, cordage, cambric, and canvas to an almost equal extent.

EAST INDIA TROPICAL FIBRES.

AMONG the valuable fibres imported from the East Indies, besides the Manilla hemp, already referred to, are the "Sun hemp," and the varieties of jute, The former is the prepared fibre of the bark of the *Crotalaria juncea*, a well known Indian plant. Its cost in India is not far from fifty to sixty dollars per ton, when properly cleaned and dressed. This fibre is almost universally employed over nearly the whole of Southern Asia, as the material for cordage, especially for coarse bale-rope. The Sun grows in the greatest abundance in Bengal, one variety attaining the height of twelve or fourteen feet, while the more common kind varies from six to eight feet in height. An acre of the plants is estimated as capable of yielding about 600 lbs. of cleaned fibre. The fibre of the Sun is longer, somewhat coarser than American dew rotted hemp. The mode of separating the fibre is extremely simple, as are all mechanical operations in India. When the seed vessels have nearly attained their full size, the plants are cut, tied in bundles, and steeped in water for two or three days; then taken out, and the

stalks broken, about a foot from the lower end, by a man standing up to his knees in water, who, holding a few of the stalks with the large ends from him, threshes the water with them, till the broken pieces are separated and fall off. Then turning them, he takes hold of the fibres that have been freed, and beats the small ends in the same manner, until the fibre is entirely separated from the stalks. A few strokes are sufficient. It is then dried and packed up for market.

The fibres imported from the East Indies under the name of Jute, appear to be derived from the bark of two species of *Corchorus*, a plant allied to the Linden tree. It is cleaned and prepared by maceration in water and subsequent scraping. It resembles the Sun hemp in many respects, but is somewhat finer, and possesses less strength.

The well known *gunny cloth*, of which vast quantities are yearly imported into the United States, is not made exclusively from any one variety of fibre, the warp not unfrequently being of one material, and the filling of a totally distinct fibre. Usually, however, it is composed of the fibres of the *Crotalaria juncea* (*the Sun*), and of the *Corchorus* (Jute). Flax and hemp never enter into its composition. Gunny is imported into the United States in the form of cloth and bags; the quantity sent yearly from Calcutta, the principle shipping port for this article, is immense, amounting in 1849 to 114,239 pieces, and 3,230,400 bags. Besides these importations, a large quantity is sent from the East Indies in the form of envelopes for other materials, as saltpetre, Java coffee, &c., &c. Owing to the great cheapness of the gunny, the bags are rarely used more than once, before they fall into the hands of the papermakers and rag-merchants. In this condition they constitute the cheapest paper stock to be procured in the market; the demand for it is not, however extensive, even at low prices, since it is impossible to bleach the fibres sufficiently to render them serviceable for the manufacture of white paper. This is owing to the fact, that the gunny fibre is procured from the bark of a tree, and contains a large quantity of humic and cremic acids, together with some mineral bases, and some tannin. These substances rapidly neutralize and destroy almost any bleaching agent which can be applied. The use of gunny is, therefore, wholy restricted to manufacture of brown wrapping and envelope papers.

The most singular vegetable fibre of the East Indies, convertible into cordage, is the production of a Sago palm. This fibre is known best as Ejoa, and resembles black horse-hair. Each tree produces six leaves in the year, and each leaf yields ten and a half ounces of the fibre, which makes the annual produce of the tree equal to about four pounds. Some of the best trees produce full one pound of fibres in each leaf. They grow from the base of the foot-stalks of the leaves, and embrace completely the trunk of the tree. Both fibres and leaves are easily removed without injuring the tree. Cables made from this unique article are occasionally brought from India to the United States, but not as an article of commerce. The cordage known in the East Indies as *Coir*, is produced from the short, woody, and apparently intractable, husky fibres of the outer envelope of the cocoanut. These fibres are prepared by soaking the husks in water for a great length of time, not unfrequently exceeding six months, or until they become soft. The husks are then dried and beaten until the woody part falls out like saw-dust, leaving only the fibres. The cordage made from the fibres so prepared, is said to be the finest that can be produced from any vegetable material.

The true hemp and flax are not grown in the East Indies to any extent for the fibres, but for the seed merely. Within a few years a society has been formed in London, under the auspices of the East India Company, to induce the natives to preserve and to prepare the fibres, as well as the seeds of these plants, but their success is yet quite indifferent. The natives are unwilling to give the labor and care necessary to clean and prepare the delicate fibres of flax, especially since they find their wants fully supplied by the fibres of the *Corchorus* and *Crotalaria*, which are cultivated and prepared with great ease and economy.

The fibre obtained in India from a species of nettle, and known as China grass, Rhea fibre, and Calooce hemp, has recently attracted considerable attention in Europe, especially in France. Treated with a hot solution of carbonate of soda, it assumes to a great degree the softness and lustre of silk, and in fact is now used to a very considerable extent as the warp of certain descriptions of French silks. Specimens of this fibre, beautifully prepared, have been sent to the United States during the past summer, and have not failed to attract the attention of manufacturers. If the China grass should become an object of demand, unlimited quantities can be obtained in India at an exceedingly low rate.

One curious fact noticed in regard to almost all fibres derived from endogenous plants, is that they do not admit of being tarred, and are not susceptible to its influence as hemp and flax fibres are. This is particularly the case with the Manilla and Sisal hemp. Tar in any case is applied merely to preserve cordage, not to strengthen it, and it is a well known fact, that tarred cordage when new is weaker than white fibres, and the difference increases by keeping. It is further worthy of notice that tar is not the produce of any trees growing in the tropics, the natural *habitat* of the endogenous plants yielding foliaceous fibres.

As a substitute for tarring cordage, the natives of the Indian Archipelago are accustomed to tan their fibres, after they have been wrought into both twine and sail cloth. The treatment is said to give additional strength. The application of tannin to vegetable fibres has not been thoroughly investigated, and it is a question, whether as a preservative of cordage its operation might not prove highly beneficial.

ON MR. WHITWORTH'S MODE OF PRODUCING PLANE METALLIC SURFACES.

MR. JOSEPH WHITWORTH is one of the English Royal Commissioners to the American Exhibition; and all those who are interested in good tools for the construction of machinery, must have observed in their exploration in the Crystal Palace, the lathes, screwing machinery, and other mechanical contrivances of this very ingenious constructor. We propose to describe in the present article the method employed by Mr. Whitworth to produce plane metallic surfaces. All workers in metal are aware of the great difficulty of securing such surfaces with a degree of accuracy such as is required for nice work. It will be shown in the course of these remarks that the usual method of grinding with emery powder is incapable of producing a plane surface.

The surface plates exhibited by Messrs. Jos. Whitworth & Co., in the New Exhibition, are formed of cast-iron, and are remarkable for the high degree of truth they possess, and for the mode adopted in preparing them.

If one of them be carefully slid on the other, to exclude the air, the two plates will adhere together with considerable force, by the pressure of the atmosphere. The surfaces should be well rubbed previously, with a dry cloth, till they are perfectly free from moisture, that the experiment may afford a fair test of accuracy. If any moisture be present it will act like glue, and cause adhesion to take place, supposing the surfaces to be much inferior. But if they be perfectly dry, adhesion proves a high degree of truth, rarely attained.

The experiment may be varied, by letting one surface descend slowly on the other, thus allowing a stratum of air to form between them. Before they come into contact, the upper plate will become buoyant, and will float on the air without support from the hand. This remarkable effect would seem to depend on the close approximation of the two surfaces at all points, without contact in any—a condition which could not be obtained, without extreme accuracy in both. The escape of the remaining portion of air, is retarded by friction against the surfaces, the force of which nearly balances the pressure of the upper plate. If one end of the upper plate be slightly raised and allowed to fall suddenly, the intervening air will act like a cushion, causing a muffled sound to be emitted, quite different from that produced by the concussion of metallic bodies.

These surfaces were brought to their present state by means of filing and scraping, without being afterwards ground. The method hitherto adopted in getting up plane surfaces has been (after filing to the straight edge) to grind them together, with emery. In some cases, it has been customary to try them previously on a surface plate, and to go over them with scraping tool; a but they have always been ground afterwards. The surface plate itself has been invariably treated in the same manner. The process of grinding is, in fact, regarded as indispensable wherever truth is required. The present examples, however, show that scraping is calculated to produce a higher degree of truth than has ever been attained by grinding. In reference to both processes a great degree of misconception prevails, the effect of which is materially to retard the progress of improvement, and which is of great importance to remove. While grinding is universally regarded as indispensable to a finished surface, it is, in fact, positively detrimental. On the other hand, the operation of scraping, hitherto so much neglected, constitutes the only certain means we possess for the attainment of accuracy. A few remarks will clearly illustrate the truth of this statement.

It is required in a surface for mechanical purposes, that all the bearing points should be in the same plane; that they should be at equal distances from one another, and that they should be sufficiently numerous for the particular application intended. Where surfaces remain fixed together, the bearing points may, without disadvantage, be fewer in number, and consequently wider apart; but in the case of sliding surfaces, the points should be numerous and close together.

A little consideration will make it evident that these conditions cannot be obtained by the process of grinding. And, first, with regard to general outline, how is the original error to be got rid of? Let it be supposed that one of the surfaces is concave, and the other a true plane. The tendency of grinding, no doubt, will be to reduce the error of the former, but the opposite error will, at the same time, be created in the true surface. The only case in which an original error could be extirpated, would be, when it was met by a corresponding error, of exactly the same amount, in the opposed surface, and the one destroyed the other. But it is evident, that where only two surfaces are concerned, the variety of error in the general outline, is not sufficient to afford any probability of mutual compensation.

It will further appear, that if the original error be inconsiderable, the surfaces must lose instead of gaining truth. It results from the nature of the process, that

certain parts are acted upon for a longer time than others. They are consequently mere worn, and the surfaces are made hollow. Nor is there any possibility of obviating this source of error, except by sliding one surface entirely on and off the other, at each move, a method which, it need not be shown, would be impracticable. It may be mentioned, as an additional cause of error, that the grinding powder collects in greater quantity about the edges of the metal, than upon the interior parts, producing the well known effect of the bell-mouthed form. This is particularly objectionable in the case of slides, from the access afforded to particles of dirt, and the immediate injury thereby occasioned. Another circumstance materially affecting the durability of ground slides is, that a portion of the emery becomes fixed in the pores of the metal, causing a rapid and irregular wear of the surfaces.

If griuding is not adapted to form a true general outline, neither is it to produce accuracy in the minuter detail. There can be little chance of a multitude of points being brought to bear, and distributed equally, under a process from which all particular management is excluded. To obtain any such result, it is necessary to possess the means of operating independently on each point, as occasion may require; whereas grinding affects all simultaneously. It is subject neither to observation nor control. There is no opportunity of regulating the distribution of the powder, or of modifying its application, with reference to the particular condition of different parts of the surface. The variation in the quantity of the powder, and the quality of the metal, will, of necessity, produce inequalities, even supposing they did not previously exist. Hence, if a ground surface be examined, the bearing points will be found lying together in irregular masses, with extensive cavities intervening. An appearance indeed of beautiful regularity is produced, and hence, no doubt, the universal prejudice so long established in favor of the process. But this appearance, so far from being any evidence of truth, serves only to conceal error. Under this disguise, surfaces pass without examination, which, if unground, would be at once rejected.

Another evil of grinding is, that it takes from the mechanic all sense of responsibility, and all spirit of emulation, while it deludes him with the idea that the surface will be ultimately grouud true. The natural consequence is, that he slurs it over, trusting to the effect of grinding, and well knowing, that it will efface all evidence either of care or neglect on his part. It thus appears that the practice of grinding has altogether impeded the progress of improvement. A true surface, instead of being, as it ought, in common use, is almost unknown: few mechanics have any distinct knowledge of the method to be pursued for obtaining it, nor do practical men sufficiently advert, either to the immense importance, or to the comparative facility of the acquisition.

Due latitude must be allowed the expression "true surface." Absolute truth is confessedly unattainable. Moreover, it would be possible to aim at a degree of perfection beyond the necessity of the particular case, the difficulty of which would more than counterbalance the advantage. But it is certain that the progress hitherto made falls far short of this practical limit, and that considerations of economy alone, would carry improvement many degrees higher. The want of it in various departments of the arts and manufactures is already sensible. The valves of steam engines, for example;—the tables of printing presses,—stereotype plates,—surface plates,—slides of all kinds, require a degree of truth, much superior to that they generally possess. In these, and a multitude of other instauces, the want of truth is attended with serious evils. In the case of the slide valves of steam engines, there is occasioned a great loss of steam power, and also an immense increase of wear and tear.*—In stereotype printing, inaccuracy of the plates renders packing necessary to obtain an uniform impression. A vast amount of time and labour is thus sacrificed, and the end is, after all, but imperfectly attained.

The extensive class of machinery, denominated tools, affords an important application of the subject. Here every consideration combines to enforce accuracy. It is implied in the very name of the planing engine. The express purpose of the machine is to produce true surfaces, and it is itself construeted of slides, according to the truth of which will be that of the work performed. When it is considered that the lathe and the planing engine are used in the making of all other machines, and are continually reproducing surfaces similar to their own, it will manifestly appear of the first importance, that they should themselves be perfect models. There is, perhaps, no description of machinery, which would not afford an illustration of the importance belonging to truth of surface, and at the same time, of the present necessity for material improvement; nor is there any subject connected with mechanics, the bearings of which, on the public interests, whether manufacturing or scientific, are more varied or more extensive.

* Mr. Dewrance, superintendent of the locomotive department of the Liverpool and Manchester Railway, in a letter to Mr. Whitworth, dated the 23d of December, 1840, says—"In answer to yours of the 20th inst. respecting the difference of the slide valves got up with emery, and those that are scraped or got up according to your plan, the difference is as follows:—I have this day taken out a pair of valves got up with emery that have been in constant wear five months, and I find them grooved in the usual way. The deepest grooves are one eighth of an inch deep, and the whole surface, which is eight inches broad, is one sixteenth hollow, or out of truth. Those that were scraped are perfectly true, and likely to work five months longer.

The improvement so much to be desired, will speedily follow upon the discontinuance of grinding. Recourse must then be had to the natural process. The surface plate and the scraping tool will come into constant use, affording the certain and speedy means of attaining any degree of truth which may be required. A higher standard of excellence will be gradually established, the influence of which will be felt throughout all mechanical operations, while to the mechanic himself, a new field will be opened, in which he will find ample scope for the exercise of skill, both manual and mental. The subject will be best illustrated by a description of the process.

There are two cases for consideration, in reference to the preparation of surfaces,—the one, where a true surface plate is already provided, as a model for the work in hand, and the other, where an original surface is to be prepared.

The former case is that which will generally occur in practice. And here the method to be pursued is simple, requiring care rather than skill. Coloring matter, such as red ochre and oil, is spread over the surface plate *as equally as possible*. The work in hand, having been previously filed up to the straight edge, is then applied thereto, and moved slightly to fix the color, which, adhering to the parts in contact, afterwards shows the prominences to be reduced. This operation is frequently repeated, and as the work advances, a smaller quantity of coloring matter is used, till at last, a few particles spread out by the finger suffice for the purpose, forming a thin film over the brightness of the plate. A true surface is thus rendered a test of the greatest nicety, whereby the smallest error may be detected. At this stage of the process, the two surfaces must be well rubbed together, that a full impression may be made by the color. The higher points on the rising surface become clouded over, while the other parts are left more or less in shade. The dappled appearance thus produced, shows to the eye of the mechanic, the precise condition of the new surface in every part, and enables him to proceed with confidence in bringing it to correspondence with the original. Before this can be accomplished, however, a scraping tool must be employed, the file not having the precision or nicety requisite to finish the operation. Experience will be a sufficient guide when to exchange the one for the other. It will be found, that when the parts to be operated upon have become to any considerable extent subdivided, scraping is much the more expeditious method. The scraping tool should be made of the best steel, and carefully sharpened to a fine edge on a Turkey-stone, the use of which must be frequently repeated. Worn-out files may be converted into convenient scraping tools. A flat file, with the broad end bent and sharpened, will be most suitable in the first instance, and afterwards a three-sided file sharpened on all the edges. It will be matter of discretion, as before remarked, how far to proceed in working up the minute detail, but it is essential that the bearing points, whether more or less numerous, should be *equally distributed*, and a uniform character preserved throughout. This rule should be carefully observed during the progress of the work, as well as at its conclusion.

In order to secure the equal advance of all the parts together, particular attention must be paid to the coloring matter, both with reference to the quantity employed, and its equal distribution. If too small a quantity be used in the first instance, it will afford no evidence of the general condition of the surface. It will merely indicate the particular peints which happen to be most prominent, and to reduce these in detail would be only a waste of time, so long as they are considerably above the general level.

When the surface is finished, if it is rubbed en the plate without color, the bearing points will become bright, and the observer will be able to judge of the degree of accuracy to which it has been brought. If it is as nearly true as it can be made by the hand, bright points will be seen diffused throughout its whole extent, interspersed with others less luminous, indicating thereby the degree of force with which they respectively bear.

In getting up a surface of considerable extent, it is necessary to take into account the strain which the metal suffers from its own weight, and the length of time required to produce the full effect on the external form. It will be found, for example, that after a piece of metal has remained for some days in one position undisturbed, it assumes a form different from that which it had while undergoing preparation. Hence, it is desirable to provide for the work, while in hand, similar support to what it will have when applied to its intended use.

Another disturbing cause is the unequal contraction of the metal in cooling, when originally cast. The mass assumes the curved form, and is pervaded by elastic forces counteracting each other. These continue in permanent activity, and any portion of metal, taken from any part, tends to disturb the balance previously established.

It remains to consider the second case proposed, viz. how to prepare an original surface. A brief description of the proper method will still further illustrate the case already considered, and will also show how surface plates are to be corrected.

Take three plates of cast iron, of equal size, and proportionate strength. The metal should be of a hard quality. The plates should be well ribbed on the back to prevent springing, and each of them should have three projecting points on which to rest, placed triangularly in the most favorable positions for bearing.

The object of this provision is two-fold,—first, to secure the bearing of three good points, before the plate suffers any strain from its own weight; and,—secondly, to insure the constant bearing of the same points. The plate would otherwise be subject to perpetual variation of form, owing to the irregular strain occasioned by change of bearing. A provision of this kind is equally necessary while the plate is undergoing the operation of surfacing, and when it is afterwards used as a model.

In fixing the plates on the table of the planing machine, care should be taken to let them bear on the points before mentioned, and to chuck them with as little violence as possible to the natural form, otherwise they will spring on being released, and the labor of filing will be increased in proportion. It is proper also to relax the chucks before taking the last cut. With these precautions, if the machine itself be accurate, and the tool in proper condition, the operation of planing will greatly facilitate the subsequent processes.

The plates are next to be tried by the straight edge, by a skilful use of which a very small degree of inaccuracy may be detected.

Let one of the three plates be now selected as the model, and the others surfaced to it with the aid of coloring matter. For distinctness they may be called Nos. 1, 2, and 3. When Nos. 2 and 3 have been brought up to No. 1, compare them together. It is evident that if No. 1 is in any degree out of truth, Nos. 2 and 3 will be either both concave, or both convex, and the error will become sensible on comparing them together by the intervention of color. To bring them to a true plane, equal quantities must be taken in both from corresponding places. When this has been done with all the skill the mechanic may possess, and Nos. 2 and 3 are found to agree, the next step is to get up to No. 1, both, applying it to them in immediate succession, so as to compare the impressions. The art here lies in getting No. 1 between the two, which is the probable direction of the true plane. It is to be presumed that No. 1 is now nearer truth than either of the others, and it is therefore to be again taken as the model, and the operation repeated.

It will be observed that the process now described includes three parts, and consists in getting up the surfaces to one another in the following order:—

1st. Nos. 2 and 3 to No. 1.
2d. Nos. 2 and 3 to each other.
3d. No. 1 to Nos. 2 and 3.

These parts compose an entire series, by repeating which, a gradual approach is made towards absolute truth,—till farther progress is prevented by inherent imperfection.

In the earliest stages, the operation may be greatly expedited by judicious management. It has been already remarked, but it cannot be too often repeated, that the general outline of the surface should be solely regarded in the first instance, and the filling up deferred till after general truth has been secured. By this method, the first courses of the series will be short, and the progress made will be both more speedy and more sure, the minuter detail being gradually entered upon, without the risk, otherwise incurred, of losing previous labor. As, however, the surfaces approach perfection, the utmost caution and vigilance will be necessary to prevent them from degenerating. This will inevitably happen, unless the comparison be constantly made between them all.

In the use of the surface plate, care should be taken to prevent unnecessary injury, whether superficial or from straining. It should also be occasionally submitted to careful correction. In no other way can a high standard be steadily maintained. It will be found convenient to set apart one plate for the purpose of correcting others, allowing it to remain entirely undisturbed. It would otherwise be necessary, at every revision, to repeat the process for obtaining an original surface, and a considerable loss of time would thus be occasioned.

A mistaken idea prevails, that scraping is a dilatory process, and this prejudice may tend to discourage its introduction. It will be found, however, to involve the sacrifice of less time than is now wasted on grinding. Were the fact otherwise, it would be no argument against the preference due to the former. But it is worthy of observation that, in this instance, as in many others, improvement is combined with economy. There is not only an incalculable saving effected by the improved surface, in its various applications, but there is also a positive gain of time in the preparatory process.

The various engine-machinery exhibited in the English department by Messrs. Jos. Whitworth & Co., of Manchester, presents surfaces prepared by the process of scraping. These surfaces are immediately recognised by their mottled appearance, resembling surfaces which have been finished in the rose lathe. This process of finishing the bearing surfaces of machinery and tools, is not entirely unknown in this country, but is far from being of general adoption, that we have not hesitated to call attention to it by a prolonged explanation of the processes which it involves.

THE WILD RICE OF MINNESOTA.

THE wild rice of Minnesota (*Zizania aquatica, L.*), the *Pshu* of the Sioux, and *Manomin* of the Chippewa Indians, is the most interesting, if not the most important, contribution exhibited by this young and flourishing territory,

the New England of the West. Like the commercial rice (*Oryza*) it is an aquatic grass, and probably an annual; its smooth, erect stem reaches a height of from four to eight feet from the root, and bears a racemose panicle of fertile flowers and fruit, at a distance of two or three feet above the surface of the water. It is widely distributed throughout the Northern United States, from the tide-water swamps of the Atlantic coast, where it is well known as the favorite resort of the delicious Ortolan or Reed-bird, to the new territories of the northwest, in which it acquires an economical importance inferior to no other production of spontaneous growth. It is the only known instance of a native grain which spontaneously yields a supply of food sufficient for ordinary consumption. As yet it is gathered only by the Indians, and constitutes their principal means of subsistence during the greater portion of the year.

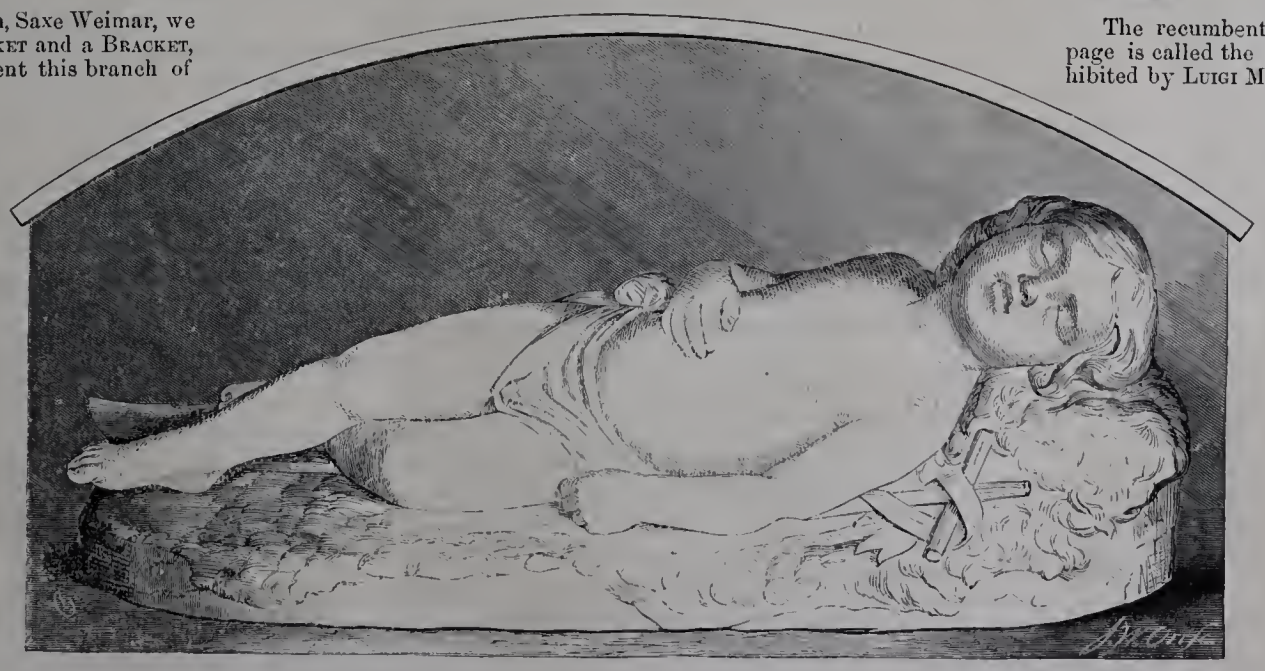
Along the numerous small lakes and shallow expansions, which form the characteristic feature of all the streams in Minnesota and the adjoining territories, the wild rice is particularly abundant, and seems to select, as its favorite *habitat*, the lower portions of these shallows, above their narrow outlet. It is rarely to be met with on the inland lakes, which have no opening to the water courses. In these situations it finds a subaqueous soil of muck and slimy sand, in which it grows most readily, and is exposed to the proper degree of inundation. In harvest time the rice fields have a considerable resemblance to fields of oats. At this season they are resorted to by innumerable birds and water-fowls, whose ravages oblige the Indians to anticipate the ripe crop, by tying up the standing rice into bundles. It is gathered in canoes by the Indian women, in the manner shown in our engraving, which we have copied from the beautiful drawing of Captain Eastman, U. S. A. It flowers in August, and is ripe in September and October. The Indians gather the wild rice both "in the milk," some eight or ten days before it is quite ripe, and also when it has come to maturity. After gathering, the grain is parched in order to separate the hulls more easily by thrashing. When prepared in this way, it is preferred to that which has been allowed to ripen fully before harvesting. The grain is small and cylindrical, about half an inch in length, and covered by a very thin, dark-colored pellicle, which is closely adherent, and imparts its dark color to the rice when it is served up. The rice is made into soup, or boiled to the consistence of hominy, and sometimes roasted in the grain and eaten dry. It is more gelatinous than Carolina rice, and according to some, more nutritious. The missionaries and the voyageurs who have become accustomed to its use, are said to prefer it to the commercial rice; and we are informed that it is sometime largely purchased by them in the absence of other articles of food, or as an agreeable variety. To what extent the wild rice could become a staple article of food and commerce, and how far its quality and productiveness could be enhanced by improved methods of culture and harvesting, it is not now possible to say. Its value in its wild state, and the fact that it grows best in swampy and overflowed lands, unfit for the cultivation of the ordinary grains, point out the propriety of making the wild rice the subject of careful and repeated experiments. We do not doubt that it will become an important element of the natural wealth of that region, though it may never rival the two staple bread-plants which America has given to the world, the potato and the maize.

The statuette which commences this page is the work of a Milanese sculptor, GAETANO MOTELLI. It is called THE DESERTED, and seems to be rightly named.

An ideal female bust, named PRAYER by the sculptor, is the production of ANTONIO GALLI, of Milan. It is a work of great truth and beauty. In the sweet expression of its features, we may read the soul that should animate the marble, serene and pure, and full of hope.

From a variety of vases, flower-pots, and similar articles in terra cotta, exhibited by the manufacturer, EDWARD SAELZER, of Eisenach, Saxe Weimar, we engrave here a HANGING BASKET and a BRACKET, which will correctly represent this branch of German Art-manufacture.

The recumbent statue which concludes the page is called the SLEEPING ST. JOHN. It is exhibited by LUIGI MAGI, of Florence, Tuscany.



We engrave a VEILED BUST, by GUISEPPE CROFF, of Milan. This work cannot be ranked higher than a mere

curiosity of art. We admire the ingenuity and practical skill of the sculptor, but not his taste or judgment.

Messrs. LINDSLEY, POWELL & Co., of Hanley Potteries, Staffordshire, contribute a variety of articles in Parian,

granite ware, &c., from which we select two PITCHERS that exhibit tasteful forms and decorations, and good workmanship.

The FLOWER STAND on the opposite page, and the one on this, with the two JUGS that accompany it, are exhibited by Mr. COPELAND. They are in Parian. We are sorry to see this exquisite material, the happy substitute for marble in statuettes and works purely ornamental,

misapplied and degraded by being moulded into jugs, cups, candlesticks, and all sorts of common-place articles, of which so many examples may be seen in the Exhibition. But besides this general protest, we have

particular objections to the nondescript jug at the top of the page. Its shape is singularly ungraceful, and the effigy which surmounts it, intended perhaps for a swan, though it were hard to say in what it differs from a goose, is a very triumph of absurdity and bad taste. To make the opening of a jug in the body of a water fowl, and convert its wings into a spout, is not a happy con-

ceit. Nor can we admire a handle, formed of a bird's neck half-strangled in attempting to swallow a plant which grows curiously out of the side of the jug, and whose sharp projecting leaves are a perpetual *noli-me-*

tangere warning, to any one who innocently supposes that a jug's handle is something by which to lift it and pour out its contents.

The monument to the eminent physician, | Dr. Conolly, needs no explanation.

The statue of The Son of Willliam Tell, is exhibited by Pasquale Romanelli, of Florence.

The Pitchers, &c., of flint enamel ware which conclude these

pages, are manufactured and exhibited by the United States Pottery

Company, of Bennington, Vt. They deserve great credit for purity of materials and excellence of manufacture.

The massive and magnificent silver CENTRE PIECE, which we engrave upon this page, is one of the articles contributed to the New-York Exhibition, by Messrs. R. & S. GARRARD, the eminent jewellers and silversmiths, of London.

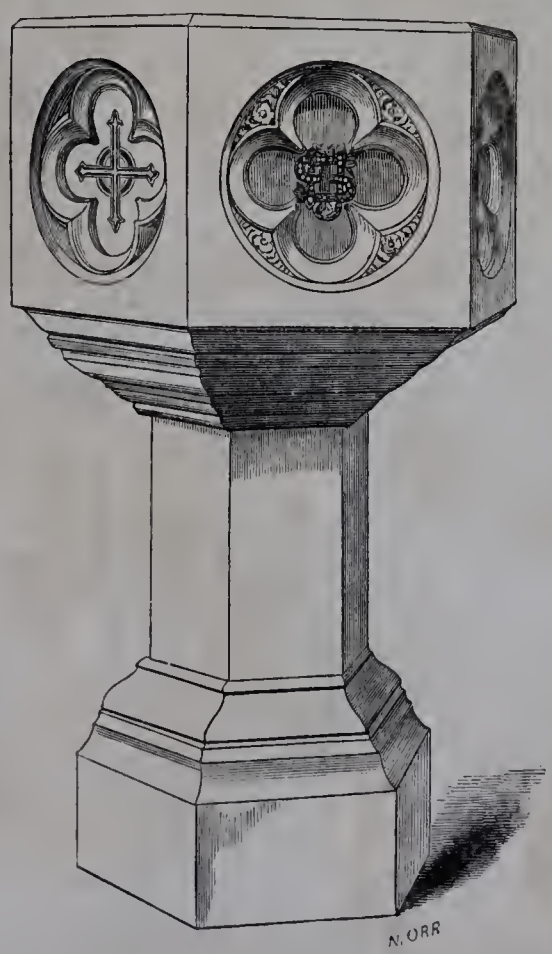
The base of this splendid piece of plate is a hexagon. It is decorated in the Moorish style of ornamentation. The figures represented are those of Saladin and Sir Kenneth, the Knight of the Couchant Leopard, and the scene is the one so well described by Sir Walter Scott, in the opening chapter of the Talisman. The Saracen and the Crusader, after their brief conflict, have concluded a truce, and have come to refresh themselves together at the fountain, above which rise two palm trees. A column also rises near it, such as the Saracens, with pious care, were accustomed to build, to mark and protect the fountains in the desert.

The silver CENTRE PIECE, which we engrave upon this page, is also from the establishment of Messrs. GARRARD. It was modelled by Edmund Cotteril, and reflects credit upon his artistic talent and skill. The scene is that famous interview in which the Duchess meets the renowned Don Quixote and his squire, with whose laughable knight-errantry all Spain had become familiar through the genius of Cervantes. The characteristics of the knight and his Rosinante, of Sancho and his Dapple, as they live in the graphic descriptions of Cervantes, are faithfully rendered in the silver.

The remainder of the page is occupied with two BRONZE VASES and their details, exhibited by LEROLLE, FRERES. We can hardly speak in terms of too high praise of the French bronzes, a branch of art-manufacture that has become eminently Parisian. For these beautiful works the most celebrated artists furnish the designs, and they are executed by workmen whose taste and manipulative skill entitle them to the name of artists also. The color of the French bronzes, which depends on peculiar processes, both in the first and final operations, is deserving of particular attention. A great variety of tints are produced, from the green peculiar to bronze, to the rich and mellow shades of golden-brown. The bronze alloy is usually made in the following proportions: copper, 82 parts; zinc, 18; pewter, 3; lead, 1½. Six thousand workmen are employed in Paris in the manufacture of bronzes.

One of the most effective works of art exhibited in the Italian department of the Exhibition, is that which we engrave upon this page—the EVE AFTER THE FALL. The

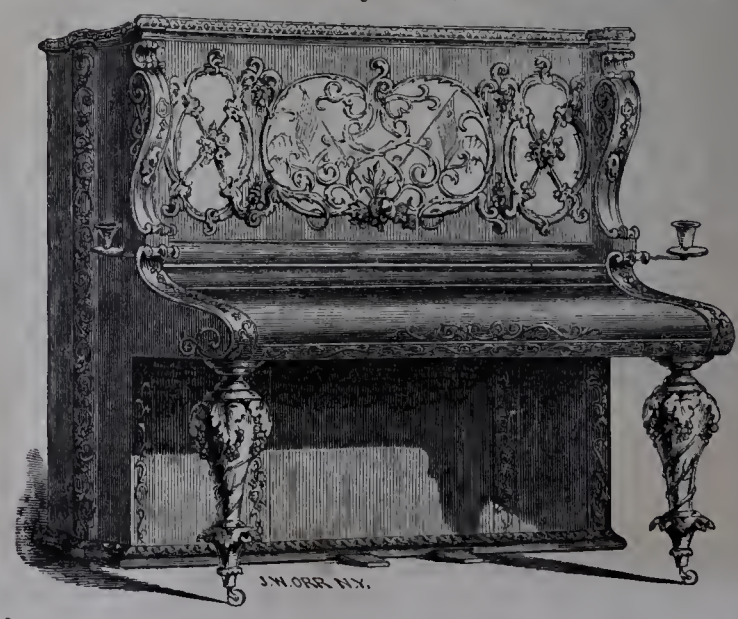
sculptor, PIETRO PAGANI, of Milan, has admirably succeeded in representing the anguish and horror which filled the bosom of Eve, when the voice in the garden pronounced the sentence for her fatal act, and revealed its inevitable inheritance of ills.



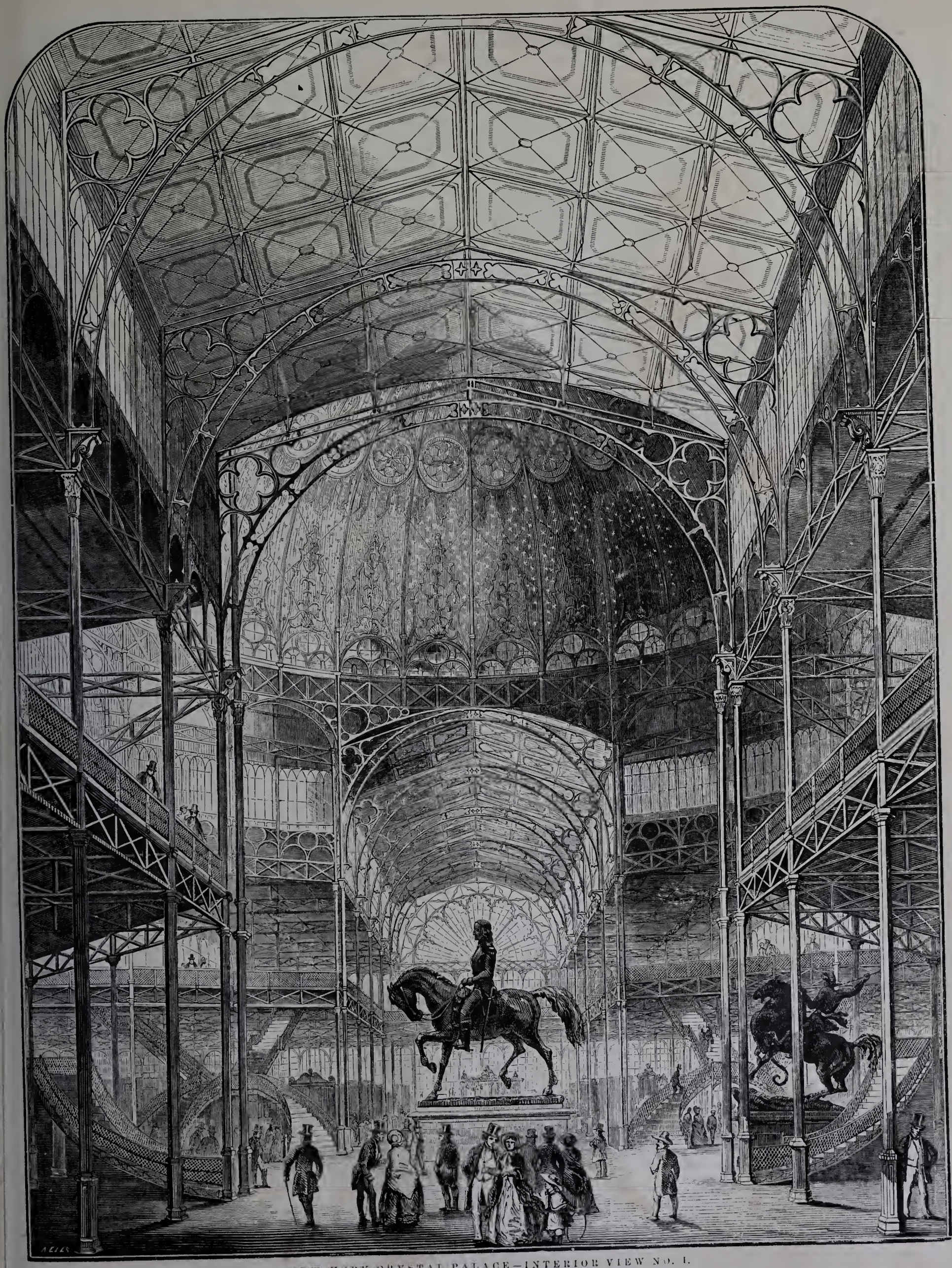
The BAPTISMAL FONT, cut from Pictou stone, in the style of the early Gothic, is the chaste production of FELIX MORGAN, of Quebec.

The STAINED GLASS WINDOW, contributed by Mr. HOLLAND, of St. Johns, Warwick, is in the Norman style of decoration. The subjects are from the life of Christ: The Raising of Lazarus, and of the Widow's Son.

A COTTAGE PIANO, which is tastefully carved, decorated with the national flags



of England and the United States, is exhibited by the EARL OF CARLISLE.



NEW-YORK CRYSTAL PALACE—INTERIOR VIEW NO. I.

MOSAICS.

THERE are few objects of art more entirely novel to American visitors at the Crystal Palace, than the Roman and Florentine mosaics—in the Italian epartment. This is one of the few branches of art in which modern skill and taste have shown themselves equal, and, indeed, superior to the ancient. The Florentine mosaics in hard stones are almost exclusively of modern origin. We alludo of course to the employment of various natural minerals cut and inlaid in a solid basis of black or other marble, in such a manner as to produce the effect of a fine painting. The ancients were well skilled in a method of their own for producing mosaic pictures on walls and pavements, but their mode of the mosaic art was, as we shall presently show, quite distinct from the modern *pietre dure*, or hard stone mosaics. As this art in all its branches is quite unknown in the United States, we propose to give some account of it for the information of the general reader.

Mosaics are imitations of paintings and of natural objects, by means of colored stones, pieces of glass, and even of wood of different colors, cemented together with much art. The Italian *musaico* and the French *mosaique* originated from the word *musaicon* of the Byzantiue Greeks, who reintroduced the art into Italy in the 13th century, after it had been driven out in the fifth century by the distracted state of the country during the fall of the Roman Empire. Little is known of its early history. It probably originated in the East, was improved by the Greeks, aud was conveyed to Italy during the time of Sylla, a century before the Christian Era. Some writers have amused themselves by tracing the origin of this art to Moses, and from him its name. A more probable conjecture regarding the origin of the name is that which refers it to the Greek word μουσειον, (museum) the original meauing of which was a grotto consecrated to the *Muses*. From the circumstance that mosaic work was often used for the decoration of the interior of grottoes, the name of these rural retreats came to be applied naturally enough to the work itself!

In Italy, and indeed in all countries occupied by the ancient Romans, many pavements and floors ornamented with mosaic work have been discovered. More ancieut, probably, than these, are the mosaic pavements discovered in the ruins of Carthage. The aucient Roman mosaic was formed almost exclusively out of small square bits of various colored marbles, serpentines, porphyries, and other colored stones set in a lime cement. These stones were arranged in various regular patterns to form fretted borders—white and black being frequently the sole colors—while the central space was decorated either with geometrical figures, or with copies of various natural objects. The Romans were, however, by no means confined to the use of fragments of natural stones to produce their mosaics, but they also employed brilliantly colored enamels similar to those in use in the mosaics of modern Rome. Among the most celebrated of the ancient Roman mosaics which have come down to our times is "PLINY'S DOVES" in the Capitol Museum at Rome. This exquisite work is very perfectly preserved and represents four doves standing on the lip of a vase of water; one is drinking, while the others are pluming their feathers. A beautiful border surrounds the composition, which was designed and used as a pavement in one of the apartuents of a Romau house. It was found in Hadrian's villa at Tivoli, in 1737, by Cardinal Furietti. Natural stones alone are used in its composition, and these are so small that 760 have been counted in a single square inch of the surface. This is believed by antiquaries to be the samc work of art which so excited the admiration of Pliny that he describes it in his 35th book. He says, "There is at Pergamos a wonderful specimen in mosaic of a dove drinking and darkening the water with the shadow of her head, while on the lip of the vase others are pluming themselves." This beautiful antique is so constantly reproduced in modern copies, both in mosaic and in sculpture, that it is probably familiar to all.

The excavations at Pompeii have brought to light numerous examples of ancient Roman mosaics, and some of them are exquisitely beautiful, both in execution and design. Such is the noble composition known as tho "BATTLE PIECE," found in the house of the Fawn, and now in the Museum at Naples. It contains over twenty figures of mounted horsemen in close conflict—some are fallen and trampled underfoot, while others are fiercely engaged haud to hand in deadly combat. The gay costnmes of the warriors—the polished circular shields in which are seen reflections of the combatants—and especially the ancient war chariot with four horses abreast, and containing apparently the leader of the onset with his charioteer—all combine to produce a most spirited picture, and to convey a vivid impression of the arms and mode of ancient warfare. The figures in this remarkable mosaic are nearly of life size, and the colors are produced by glass enamels as well as by natural stones.

The chained dog with the inscription "Cave Canem" (beware the dog), is a most life-like and startling mosaic which formed the floor at the entrance of the house of the Edile, Glaucus. Another well-known and beautiful example from the same city, is a casket of jewels, from the open top of which two doves are drawing a necklace of pearls. This last-named mosaic has been suffered to remain where it was found in the pavement of one of the apartments in the so-called house of Sallust. It is formed entirely of small squares of various natural stones.

The only representative of the ancient Roman mosaic pavement found in modern Italy is the Scagliola, in which irregular shaped fragments of various sizes of colored marble are imbedded in a calcareous cement, sometimes in symmetrical patterns, and afterwards polished down to au even surface. Such are the common floors of modern Italian houses—so well suited to the climate and habits of the country.

It has been suggested that the mosaic pavements of the Romans were formed by arranging the separate pieces in an inverted position on a flat surface upon which the design had been traced in outline, and then covering the back or underside of the whole system of pieces with the cement which was to secure them in place. Afterward the whole mass being turned over and secured in its destined position, a perfectly level surface could be secured without the trouble of grinding or polishing down the irregularities which would certainly exist if the mosaic had been formed in the position in which it was to remain, owing to the impossibility of inserting such minute fragments in a soft and yielding basis to a perfectly uniform level. This explanation is probably the true one.

THE MODERN ROMAN MOSAICS are exclusively of glass enamels. The preparation of the pastes or colored glasses (always opaque), forms a separate branch of industry; they are made of very fusible materials, colored by oxyds of metals and tempered to every possible shade of color. It is said that the magazines of the papal manufactory of mosaics in the Vatican, embrace not less than 10,000 shades of the various colors. These enamels are drawn into rods or sticks like sealing-wax, of various sizes, according to the work to be done, and are skilfully arranged in a series of compartments to facilitate the artist in the rapid prosecution of his work. From the ends of these colored rods, bits are broken off by the artist, who then sticks them upon a bed of soft cement, formed of quicklime, pulverized limestone and linseed oil. This cement is evenly spread upon a surface of metal or a slab of stone, and upon it is traced an outline of the picture or work to be copied. Following this tracing, and with the original pictures placed on an easel beside him, the artist proceeds in the most laborious and patient manner to select and arrange the shades of color necessary to form a perfect copy of the work. These tints must not only be skilfully selected for color, but the individual bits must also be made to fit each other, leaving no spaces between themselves. For this purpose he has frequent recourse to the blow-pipe lamp, in whose flame the enamel easily melts, and may be drawn out to the required size and form. When the whole surface has been thus covered, some weeks or months are required for the cement to become hard and firm enough to withstand the last process. This consists in grinding down by emery powder the uneven surface of the mosaic, until a perfect level and a beautiful polish are produced. It is only after this last step that the beauty of the design and the perfection of the work can be judged of. Before polishing, the surface presents only a dull, rough appearance—seemingly a very imperfect copy of the original. The time consumed in producing by this method copies of large pictures is very great. For example, the transfiguration by Raphael, copied in mosaic for the decoration of St. Peter's (a mosaic probably 30 feet high), occupied several men over twenty years. When once, however, a grand work is produced in mosaic, it is as nearly immortal as it is possible for man to make any thing. The materials employed are liable to no change from the causes which render oil paintings and even frescoes so destructible. Undiminished in the brilliancy of its colors and untarnished by time, it goes down to posterity exactly as it came from the hands of the artist. Fire may defaee and violence may destroy it, but from all other causes of decay and injury it is exempt. We well remember the feeling of amazement with which we gazed for the first time on the mosaics of St. Peter's and of St. Mark's at Venice. It is only by close inspection that the observer detects that the beautiful copies with which St. Peter's is lined are not either oil paintings or frescoes, so perfectly are the forms and tints of the originals reproduced in so unmanageable a material as glass enamel.

For works to be seen close at hand as in tables, brooches, and small copies of works of art, the size of the individual pieces composing the mosaic is very small, so that the several parts can be detected only by a close inspection. On the other hand, for works to be placed in the domes of churches or on lofty side-walls, tho pieces employed are of considerable size. The dome of St. Peter's for example, is entirely lined with gold mosaic, in which are set mosaic medallions of cherubs, angels, aud other appropriate figures. From below, at the distance of 400 feet, these have all the softness of paintings, but the observer is astonished on coming close to them to find the pieces of enamel so large that not more than four are required for a square inch of surface. The size of the mosaic pieces selected for a given work must be the same for the whole surface, any material change in this particular in the different parts of the same picture being productive of bad effects on the harmony and beauty of the whole. The gold

mosaic surfaces are of a very ancient origin, and were largely employed by artists of the Byzantine period in imitation of the then prevalent taste of painting in oil upon a gilt background. The effect when seen in such masses as we find in the domes of St. Mark's and of St. Peter's is very gorgeous, and speaks of its oriental origin. The gold mosaic is produced by employing any convenient enamel for a basis over which the gold is spread in a thin and perfectly even film, by means of some adhesive size or varnish. It is saved from destruction by time, and the brilliancy of its effect heightened by a covering of very thin and transparent glass, which being pressed upon the soft surface at the gold size adheres perfectly. Thus the gold surface is plated or veneered by the thin glass.

The art required to produce good mosaic pictures in the Roman method is far from being mechanical in its character. It certainly requires more skill to excel in this branch of art than to produce good copies in oil, and probably quite as much as to execute a fine engraving. Cav. Luigi Moglia is one of the most celebrated mosaicists in Rome, and his well-known work representing the temples of Paestum on a scale of seven feet, is not surpassed by any mosaic of modern times.

The works in Roman mosaic in the New-York Exhibition, are a head of St. John, from Guerchino, by the artists of the Papal manufactory in the Vatican, his Holiness Pio Nino being the exhibitor; a copy of "Pliny's Doves" in the adjoining court, in a circular table by Francesco Betti, of Rome; and a large pavement slab of coarser work by Idoardo Prebbi, of Rome, representing fish and dead game in a rich border. The head of St. John is much the most signal of these works. It is of the same sized mosaic pieces as those composing the famed copies of St. Peter's before mentioned, and to see it well the observer should stand upon the opposite side of the nave. The work was never designed to be seen so near as it may be approached in its present position. There is a fine geometrical table in the Austrian department by J. Giracomenzzi, of Venice, which may be named in this connection since it is formed entirely of enamels, although these are joined in the Florentine manner. It is a copy of a well-known pavement in the church of St. Mark's of Venice. In this work may be seen fine specimens of the celebrated goldstone or aventurine glass, for which Venice has long been celebrated.

It has been proposed to multiply copies of the Roman mosaics by employing the enamel rods of such length, or depth, that successive sections could be cut from the surface, each section being cemented to a separate basis, as several thin slices of valuable stones are cut from one slab.

The Florentine Mosaic.—The present Exhibition embraces several very beautiful examples of the hard stone mosaics, for which the Florentine artists are so celebrated. We name particularly a beautiful oblong table four feet by two inches by Sr. Francesco Betti, Florence. An engraving of this design is given in the Record, but without the lively colors and brilliant polish of the original—wanting which, the engraving gives but a feeble idea of the beauty of the original. Numerous other works in the same style will be observed in the Italian gallery, of which we name particularly eight tables of various forms by Enrico Bossi, and five by Gaetano Bianchini, both of Florence, the workmanship of which will bear the closest examination both for taste and skill.

In the French department are two tables by Faqueson Cie, formed of small squares of various colored marbles arranged in Saracenic patterns after the style of the ancient Roman mosaic.

We should also be very remiss if, in speaking of this subject, we failed to advert to the abundant display of hard stone mosaic in the English department of the Exhibition. John Tomlinson, of Ashford, near Bakewell, Derbyshire, and John Valance, of Matlock Bath, Derbyshire, have both a number of black tables inlaid in the Florentine manner with various ornamental stones. Beautiful as those works are, however, it is plain that there is in them all a decided inferiority both in taste and workmanship to the Italian.

The Florentine mosaics, as before remarked, are formed exclusively of various hard minerals, which are cut in thin slices, and the colors so selected as to produce the effects sought by the artist. To do this, it is necessary to have a very extensive stock of specimens of various minerals sliced to the proper thickness, from which the selection is made. The selected pieces are then to be cut for the outline with the greatest accuracy, so that the joinings will be invisible. And, lastly, the several pieces forming the design, are to be inlaid in the body of the slab which forms the basis of the whole. The chief establishment for the production of this description of mosaic work, belongs to the Grand Duke of Tuscany. It requires regal wealth to enable the artist to devote years of time to the completion of these exquisite objects which form the material of princely gifts. There are, however, numerous private establishments in Florence which produce good Florentine mosaics, of whose skill the specimens already named are examples.

The usual basis in which the Florentine mosaic is inlaid, is a beautiful jet black marble—although white and various other colors are occasionally employed. This basis is not of great thickness—since the labor and difficulty of perforating its surface for the insertion of the mosaic pieces, is much diminished by its being moderately thin. The requisite strength is afterwards obtained by backing it with metal or stone cemented on. The means employed for cutting the intricate openings in the basis, to receive the mosaic patterns, are as wonderful for their simplicity as the result is admirable for its beauty. A thin soft iron wire is stretched like a bow-string, and being armed with emery and water, the artist sets himself patiently to saw with this simple but most efficient instrument. He follows with perfect certainty the most tortuous and intricate lines, and with a degree of rapidity which is remarkable, if we remember the nature of the material to be cut. A drill furnishes the means of obtaining the first perforation, and the same instrument is the only other aid the artist requires in his work, as when, for example, hemispherical cavities are to be formed for the reception of transparent amethysts, if a bunch of grapes is to be produced. A beautiful example of this fruit in Florentine mosaic, is to be seen in the Exhibition in the first specimen cited above.

Far more laborious and artistic is the other portion of the task in this art. To select and adapt the various hard stones, whose lively and natural colors are to reproduce in life-like beauty—the olive branch, the forget-me-not, the crimson cherry, half hid in its green leaves—the gay and fluttering bird, or whatever other object of nature it may be proposed to copy. To secure success in this part of the art, all the hidden treasures of the mineral kingdom have been searched and brought to light. It is here worthy of remark, that Nature with her customary simplicity in complexity, has placed at the artist's disposal a single mineral species, whose varieties in color, transparency, and purity, have furnished the Florentine artist nearly every thing he could ask. This protean mineral is quartz, or silica, whose varied names exceed the loftiest reach of Spanish patronymics. The varied tints of the agate, the bloody carnelian, the purple amethyst, the liquid sea-green chrysoprase—the various tints of opaque prase, from the light foliage of the olive to the deep green of the ivy—the banded onyx, the chalcedony transparent and seemingly tremulous as jelly, or opaque, and spotless as milk—jaspers, opaque and of every hue, of a single tint, or banded, and imitative like the Egyptian pebble—the gold-spangled aventurine, and many other varieties of the same parent stock go far to furnish the magazines of the Grand Duke, from which are drawn the soft or rainbow hues whose grouping produces so charming a result. Add to the family just named, the soft blue of the turquoise, the inimitable tint of the lapis-lazuli, the rich green of the malachite with its exquisite bands of concentric layers—the verd-antique porphyry, and all the nameless tribe of porphyries and marbles, and for rarer and more costly works, the emerald, the garnet, the sapphire, the topaz, the peridot, and even the diamond, and we have some notion both of the resources and the difficulties of the Florentine mosaic. The cutting of the hardest of these minerals into thin slabs, is accomplished by the lapidaries' wheel, armed with diamond dust, while to shape the selected pieces to fit the adjoining parts, requires the bowstring of wire armed also with the powdered diamond.

It is only in Italy that the highest triumphs of this art can be seen. In the Pitti Palace, and in the Chapel of the Medici, as well as in the private chapels of some of the wealthy families, are found tables and tablets in Florence mosaic, whose value is untold. Such very elaborate and costly products of artistic skill, are certainly not to be looked for in a youthful country like our own, even if they were to be desired. It is not, however, the less instructive or delightful, that we have now, for the first time in America, the opportunity of refreshing our eyes by looking upon some examples of this beautiful art, and we rejoice that there is that in every human soul which answers to the sentiment of beauty however it may be expressed.

THE CHROMATIC DECORATION OF THE CRYSTAL PALACE.

IT is not our intention in the present article to add to the numerous treatises on Decoration, which subject has been already most thoroughly investigated by very able writers; but in noticing that of our Crystal Palace, to call attention to the fact, that this style which is usually left to the experience of the house-painter, or the fancy of the proprietor, is subject to fixed natural laws, and may be so carried out in its execution as to constitute a work of art.

This style may most properly be termed *Chromatic*, or a decoration arising from the harmony of the colors used in painting the building. The German terms *mono*-chromatic and *poly*-chromatic seem not only unnecessary but incorrect. As no single sound has an independent beauty, and receives one only when combined with or opposed to another; in the same way, no single color has a beauty *per se*, and affects the eye as beautiful, only when harmonizing or contrasting with another. In decorations effected by *one* color varied only by light and shade, the pleasure which the eye receives is from a perception of the harmony or grace of *forms* indicated. Thus, what has been termed *mono*-chromatic is a decoration purely of *design*, in which color plays no part.

Most of the works on decoration with which we are cognizant, treat the subject as one of mere design, or, of design enriched with color. The Italian style, known as the Arabesque, consists of fanciful combinations of animal forms

with fruit, flowers, foliage, shells, architeetnre, &e., sometimes as mere borders to embellish a painting, and often filling the eutire space to be decorated. In these designs the objects are sometimes represented in their natural colors, producing a chromatic effect, sometimes only in chiaro-oscuro, in which case, as before hinted, the decoration is one of *design* only.

The Moorish system, of which the Alhambra furnishes a familiar example, is (strictly speaking) neither chromatic nor one of design, according to the usual acceptation of the word which implies the imitation of natural forms. The colors almost invariably employed are pure blue, red and yellow, or gold as a substitute for the latter color. From their simplicity they are ineapable of forming of themselves other than the most ordinary melody, exceedingly monotonous and tiresome to the eye. They are distributed, however, within certain ingeniously varied lines and patterns, and the decoration resulting is one of purely geometrical forms, attracting the eye by the difference of their colors. The essential feature of this style, then, consists in the exquisitely varied and harmonious tracery whieh breaks up the surfaces. Mr. Owen Jones' decoration of the London Crystal Palace exhibits the results of employing the primitive colors, and omitting the geometrical harmony of the Moorish style.

The employment of color alone as a means of giving additional beauty to architecture, is a snbject of greater importance than is usually conceded to it. Many of the materials used in building are perishable in their nature, and require a coating of some kind of paint for the mere purpose of preservation; but, to elothe discordant materials with a harmonious arrangement of color, so as to form a pleasing whole, is of far greater importance to the artistie effect of the work, and requires a knowledge of the resources of color not inferior to those of form by which the architect is guided in his compositions.

If we reflect on the immense use which Nature has made of color as an instrument for beautifying her choicest forms, and imagine what we should lose if they were elothed in a negative tint, we may form an idea of the value of color as a means of giving beauty. If we carry the imagination farther, and conceive the natural order of colors reversed, we feel at once the importance of using them in works of art in accordance with the laws of nature.

The theory of colors is of a very recent development, and a knowledge of the laws deduced, is confined to very few even of those who require it in the exercise of their professions. It is rarely that we find praetitioners even in the higher branches of painting, who are guided in their compositions by any other principle than those suggested by individual taste, and a cultivated eye. It is a question worthy of consideration, how far the mediocrity of painting of the present day is attributable to an overweening reliance on natural powers, and a neglect of the lights of seience. In the sister art of music, we continually see that those who refuse instruction in the theory of the art rarely attain to any excellence, while those who study profoundly, advance steadily, in proportion to their natural endowments. We are thoroughly convinced that much genius is now wasted in the acquirement of rudimentary knowledge in the slow school of practical experiment, and that the excellence of the Greek school of design arose from a thoroughly digested canon of form, and the use of geometrical formulas which make the compositions of second and third rate artists of that period the wonder and admiration of the present day.

Within the last twenty or thirty years has appeared a series of works on color, among whieh that by Mr. D. R. Hay, of Edinburgh, "On the Harmony of Colors" is a very remarkable essay, not only for its lucid and practical exposition of the laws of eolor, but for the many scientific and artistic truths presented. This writer proves very eonclusively that the seven colors of Sir Isaac Newton are reducible to three primitive ones, blue, red and yellow; that they form, in binary combination, the seven prismatic tints eorresponding to the seven notes of the gamut or musical scale; and that a variation in the admixture and arrangement of them, according to the same numerieal laws as those which regulate harmony and melody in music, produces an infinity of compositions of color, whieh afford an exquisite pleasure to the eye analogous in character and equal in variety to that which music has for the ear. That a strong analogy between these arts has for a long time been felt to exist, is evident from our employment of the same terms to express similar effects in music and color; but Mr. Hay, we believe, is the first one who has demonstrated that the laws governing these two arts are identically the same.

There are some facts connected with this analogy as instructive as they are curious. They are both *non-demonstrative* arts. Neither affirming nor proving any thing, they each illustrate, amplify and heighten the force of every expression of truth. *Sister* arts, they are in themselves not generative of ideas, but require union with a creative art for a full development of their powers. Thus eolor joined to design rivals music "married to immortal verse." Divorced, they are to be appreciated only by minds sufficiently cultivated to supply the absence of the conjugal art. To such, music is most attractive when purely instrumental; they preferring to supply the thought or sentiment. On the other hand, with many the love of color is so predominant that a third-rate specimen of the Venetian school has charms beyond the most exquisite designs of the Florentines or Romans. The former artists, if inferior in design, are pre-eminent as *painters*. Color in their hands has all the expression of language in poetry. Their works may safely be referred to as canons of color, and exhibit a proof of the infinity of variety, of which the tones and eombinations of coloring are eapable. Many of them have so little merit on the score of design or expression of thought, as to suggest the question whether they are not mere instances of the instrumental music of eolor, and, whether a similar arrangement, pleasing to the eye solely on account of its harmony, its variety and due proportion between the quantities of quiet and brilliant colors employed, if judiciously applied to a building, may not eonstitute an instance of color handled as an art.

The fact that coloring matter in natural objects corresponds to organization, and always indicates a function, has been used as an argument to prove that the employment of color without regard to function, is eontrary to the laws of nature, and therefore inadmissible in art. This argument derives its plausibility from ignoring the distinction between nature and art! It is not only the prerogative, but sole resource and province of art to enter the fields of nature, and seizing upon any of her laws to apply them to her own creations. While nature deals with *life*, art operating on *dead matter* is foreed, like Prometheus, to steal fire from heaven with which to animate her works. Hence the variety of forms whieh art is capable of assuming is limited only by the infinity of nature's prineiples.

A decoration arising chiefly from the harmony and variety of colors introduced, is the style attempted, in a simple key, in our Crystal Palace, to whieh we refer by no means as evidence of the *extent* to which it may be carried, but merely as a commencement in that *direction*. The shortness of time allowed for decoration, the diffieulty of obtaining a large number of experienced workmen at short notice, and the ephemeral eharacter of the building, all pointed to a broad and bold treatment of the subject, not only as most feasible, but most eonducive to the purposes of the Exhibition. It seemed desirable to furnish a modest and appropriate background to the articles exhibited, rather than to make the building the ehief object of interest.

The following rules, many of them applicable to the most complicated, as well as the simplest systems, have been mainly adhered to in the design of the decoration of the interior:—

I. Deeoration should in all cases be subordinate to construction. It may be employed to heighten or give additional value to architeetural beauties, but should never counterfeit them. Being in the nature of an aecompaniment, it should keep in modest aecordance with the air, and not drown it with impertinent embellishment. Coloring, to be employed with good effect on a building, should resemble the drapery of the antique sculptnres, which, displaying between its folds the forms beneath, serves rather to enhance than to conceal their beauty.

II. All features of main construction should have one prevailing tint, enriched occasionally by the harmonious contrasts of that color. All secondary, or auxiliary construction, may be decorated by the employment of a richer variety of the prineipal color. This mode of treatment is suggested by the distinction whieh nature has made between the coloring of the trunk, branches, twigs and leaves of trees.

III. The prevailing color of the ceilings should be sky-blue, thus borrowing from nature the covering which she has placed over our heads. Monotony may be prevented by the introduction of orange (the natural complement of blue), garnet and vermilion, in such quantities only as may be necessary to recall these colors employed elsewhere.

IV. Rich and brilliant tints should occnr in small quantities, and be employed to attract the eye to the articulations and noble portions of the members, rather than to the members themselves. As in the human figure, variety of color and form is most displayed in the extremities and joints, to which the broader style of the limbs and trunk serve as a foil, so in buildings, the bases and capitals of columns, brackets of arches, and the framework of panels, would seem legitimate objects for the reception of rich coloring. Occurring at fixed numerical distances, they are measured out in equal proportions as to space, and afford also a due quantity of brilliant and stimulating tints—suffieient to enliven the large proportion of mild color so essential to a general effect of quiet and repose.

V. All natural beauty of eolor existing in any material, should, if possible, be brought into play, by using that color itself, instead of covering it with paint of another hue.

VI. The leading feature of beauty in the Crystal Palace, being that of proportion and geometrical harmony, rather than elaboration of detail, all ornament introduced should be of the same character, mere geometrical outlines and forms to the exclusion of classical decoration, the characteristic of which is an imitation of the organization of foliage.

VII. White should be used in large quantities in all cases of simple compositions, not only to give value, by contrast, to the few colors employed, but to reflect light and cheerfulness to the work.

An adherence to these rules has produced a style of decoration pleasing from its novelty and from the harmony arising from the use of color in accordance with the laws of seience and the practice of the best masters. It presents to the eye a

harmony composed in the key of orange and blue, varied by the introduction of more brilliant and compound tints in small quantities. This combination was selected as being peculiarly adapted to the interior. Sky-blue, which is confined principally to the dome and ceilings, serves to give an appearance of loftiness and airiness; while its complement, diluted orange or cream color, not only balances the blue harmoniously, but throws a cheerful tint of sunshine over the whole of the interior. It has the further merit of being of a subdued hue seldom occurring in manufactured articles, and therefore serving as an excellent background to the mass of objects exhibited.

The power of blue to give an effect of loftiness to the building was strongly exemplified during the progress of the painting, by comparing one of the naves which had been decorated with another which remained unfinished. The former seemed more than double the height of the latter, although they are all of the same dimensions. It was equally interesting to observe, that the introduction of a variety of colors, into large spaces, has the effect of magnifying the apparent dimensions to a wonderful degree. Space and grandeur are elements of so much importance in architecture, that we cannot afford their loss. If a building of great dimensions appear small, it is to be attributed, not to its *fine proportions*, as is sometimes alleged, but to a neglect of its projector to avail himself of one of the most effective instruments of his art.

In accordance with the general character of the building, no ornament of classical forms has been introduced. The only attempt to decorate by means of design, has been in the use of mere geometrical lines and figures of a very simple character, which have been executed by common workmen, assisted only by the use of stencil patterns. The ceilings of the four lean-tos are all different, those of the galleries are of a fifth pattern, and the four naves have still another design in common. Thus the lean-tos, which can only be viewed separately on account of their remoteness, offer a variety among themselves; but to the spectator looking upward, a perfect uniformity in the galleries and naves is presented, above which rises the dome, still varied in design but harmonizing with the rest. This portion of the decorations, which is of the florid Moorish character, rich in color, and flashing with a profusion of gold and silver ornaments, when viewed by the favorable light of gas, forms a crowning grace and beauty to the Palace, imparting a fairy-like and magical effect to the whole.

The treatment of the exterior requires very few words of comment. It is painted of a uniform bronze tint or olive, enriched by gilding all ornamental features, such as the quatre-foils, the pinnacles and railings. Where large surfaces occur, a rich orange tint, in imitation of gold, has been substituted for gold-leaf, as more economical. We have heard it objected to the decoration of the exterior; first, that by it the real material of construction is concealed; secondly, that the imitation of a more costly material constitutes a *deception*. In answer to this, we claim the benefit of a distinction between *counterfeiting* the appearance of a material and borrowing an arrangement of color suggested by it. In the present instance, no attempt to deceive has been made, but, on the contrary, the use of bronze powder and all other expedients, by which painters endeavor to make a perfect imitation of *real* bronze, have been expressly avoided. Since constructions of iron require paint to preserve them from rust, we can conceive of no consideration affecting the choice of color, other than the character of the building itself and its relation to surrounding objects.

ULTRAMARINE.

THE artist and the decorator are indebted to the science of chemistry for three of their best and most permanent colors, and of one of these—artificial ultramarine—the present paper contains the history. At the same time it is a striking illustration of the manner in which science continually aids the progress of the useful arts.

For many centuries, the beautiful stone called *lapis-lazuli*, has been known and valued for its rarity and for its color, a rich, deep azure-blue, such as no other mineral possessed. It was brought from China, Siberia, and Persia; and it was also found on the banks of the Indus, disseminated in a grayish limestone. Its richly colored varieties were employed in the manufacture of mosaics, and specimens of it thus used, may be seen in the mosaics of the Italian department of the Exhibition. When it occurred in masses of sufficient size, it formed the material of vases and similar ornaments, whose beauty was enhanced by their costliness. Magnificent slabs of lapis-lazuli still adorn some of the cathedrals of Italy. The fragments of lapis-lazuli were scarcely less valuable than the masses. When pulverized and mixed with wax, resin, and linseed oil, and kneaded with water, the mineral deposited a powder free from impurities, and of a blue color unequalled for beauty and permanence. This blue received the name of ultramarine, and was sold for its weight in gold. Its manufacture remained in this condition for many centuries, and its use therefore was very limited.

In 1814, Vauquelin, a distinguished chemist of France, found an unknown blue substance in a furnace, used for the manufacture of soda. Upon analysis, he ascertained that its composition was the same as that of lapis-lazuli. Alumina, silica, soda, sulphur, and iron, the constituents of the precious mineral, had met, by accident, in the proper proportions, and formed it artificially. From this observation, Vauquelin predicted the future manufacture of artificial ultramarine, by synthesis, or the combination of the substances that compose it in their proper proportions.

The predicted discovery was made in 1828, by Guimet, also a French chemist. The prize which had been offered for it by the *Société d'Encouragement*, was given to him on confidential communication of his process to Gay-Lussac. Guimet has never made his process public, but the attention of other chemists being drawn to the subject, other processes, or perhaps the same, were discovered and published by Gmelin, Robiquet, Persoz, Kocttig, and Brunner. The process of Robiquet, which seems to be the simplest and most practical of those published, is as follows:—

A mixture of two parts of porcelain clay, three parts of sulphur, and three parts of dry carbonate of soda, is gradually heated in a close earthenware vessel until it ceases to give off vapors; the resulting green porous mass is washed with water, and the blue powder, which remains undissolved, is again heated to redness to expel the excess of sulphur. (Annalen der Pharmacie 10, 91.)

The manufacture of the artificial ultramarine on a large scale, dates from this time, and has since rapidly increased, and this product will ultimately become as important an article of commerce as vermilion or white-lead. The price has already actually been brought down by competition between manufacturers and the rapid increase in the demand, to something like half a dollar per pound, being just one six hundred and forticth part of the cost of the natural ultramarine, formerly made from lapis-lazuli.

At the London Exposition in 1851, there were a number of exhibitors of this product, among whom, Guimet, the first discoverer of the process, was judged worthy of the highest prize, a Council Medal. Guimet is also an exhibitor in our Crystal Palace, but it remains to be seen whether two years of improvement have not enabled some of the great number of other exhibitors whom we have, to surpass him in the art. It is very possible that the credit naturally attached to a first discoverer may have had some weight with the jury of the London Exhibition, but it would seem as if the non-publication of his process by Guimet should annul any claim which he may have on that ground over other independent discoverers. There are certainly many specimens on exhibition at present, which, on superficial examination, seem to be of a much deeper and purer azure color than Guimet's, but in such a delicate point as this none but the highly trained eye of an artist can be trusted. There are other tests which must also be applied in deciding the relative values of ultramarines, besides the mere impression upon the sight. Thus the degree of opacity, or the *body*, as it is technically called, when mixed with oil, is an important point. The artist's practical test for deciding the relative values of two or more samples, is to mix each with about equal quantities of white-lead and oil, and compare the resulting tints. The sample which has the greater *body* will of course exhibit the darkest color.

Ultramarine may be distinguished from Prussian blue, smalt, cobalt-blue, and all other blue substances whatever, by the following test: when diluted sulphuric or muriatic acid is poured upon it, it is decomposed, with total loss of color, and evolution of a fetid smell, due to the formation of sulphuretted hydrogen gas. The presence of ultramarine in any substance which has been dyed or colored with it, may be easily detected by this test. The ordinary bluish-colored letter paper answers to this test. On being wetted with the diluted acid, it is immediately decolorized, and the presence of sulphuretted hydrogen gas in the surrounding air is readily manifested, not only by the strong peculiar smell perceived, but also by holding over the paper a common glazed card, moistened with water, which is immediately turned brown, a brown sulphuret of lead being formed by the action of the sulphuretted hydrogen upon the white-lead with which the card is glazed.

The property of ultramarine mentioned above, of being decomposed by diluted acids with loss of color, is taken advantage of in a process recently proposed by a German chemist for determining the relative values of ultramarines; but the process is one which is not susceptible of elucidation to the general reader, and which cannot be executed with precision, except by the educated chemist. The best practical test for the use of the consumer, is that by mixture with oil and white-lead, as before described. It would be useful also to the artist to keep some diluted sulphuric acid at hand, and ascertain whether his ultramarines are completely decolorized by being drenched with it, which would indicate the absence of adulterations, such as Prussian blue, smalt, indigo, etc., because none of these latter substances are at all affected by the acid.

There is another application of ultramarine, besides its use by the painters, to which we must give some attention. The dyers and calico printers, whose arts have been advanced so wonderfully during the present century by the application of chemical science, and who, taught by experience, are always upon the *qui vive*, and eager to seize any new application, must have seen, as the artificial ultramarine cheapened in price, the advantage which would accrue to them if they

could succeed in imbuing their fabrics with its rich blue color. But here a colossal difficulty immediately occurred. All their colors had been previously applied to their fabrics in the form of solutions, or by precipitation from solution. But no one could succeed in discovering any means of dissolving ultramarine: and, in fact, from the nature of the substance, the discovery of any solvent for it was to be despaired of. Under these circumstances, there was apparently as little prospect of success in fixing ultramarine upon cloth in such a manner that it could not be washed off, as of fixing in the same way powdered charcoal or any other perfectly insoluble substance. The aid of the chemist, so often invoked, was again solicited, and the use of *albumen* suggested. Albumen is a liquid substance, soluble in water, which, upon the application of heat, becomes solid, and perfectly insoluble in water. The white of eggs consists principally of albumen, and the white of eggs mixed with water was accordingly the substance used by the calico printers and dyers. The ultramarine in fine powder was diffused through this solution, the mixture then applied to the cloth, and the albumen afterwards coagulated by the application of heat. Every particle of ultramarine which adhered to the cloth, is thus enveloped and bound fast to its fibres by a coating of insoluble albumen, which wholly prevents it from being washed off by water. Modifications of this process have since been invented which cheapen it very much, and which are now used very extensively in England and Scotland. The albumen of milk is now substituted for that of eggs, and the buttermilk of the dairies, which was once wasted or fed to animals, is now sold to the calico printers.

Ultramarine has one property which gives cause of complaint to the manufacturers of ornamental paper and others. This is its incapability of being polished or *glazed*, as they term it, its peculiar structure being such, that a reflecting surface cannot be produced upon it. This property may be accounted for, by supposing the granular particles to possess an uneven vitreous fracture, like that possessed by the natural mineral lapis lazuli, so that the more a surface covered with ultramarine is rubbed for the purpose of polishing it, the greater the number of minute irregular faces produced, which reflect light in all directions, and consequently the duller and less reflective the surface becomes. At the same time, it must be remarked that the beauty of ultramarine for most of its uses is due in a great measure to this very property of producing a dead surface like deadened silver. There is a variety of ultramarine called *ultramarine green*, which seems not to have been introduced into the market to nearly so great an extent as the ultramarine blue. There are on exhibition in the Palace several specimens of this product, which present, nevertheless, a very good color, and when we consider the economy which must eventually be found in the manufacture of this substance above all the other green colors at present in use, such as Paris green or Scheele's green, the main constituents of which are two costly substances, arsenic and copper, verdigris, which is also a copper compound, and chrome green, we may reasonably expect ultramarine green to become in future an extensive article of commerce.

The various processes which have been proposed for making ultramarine green, are essentially the same as those for the ultramarine blue, except that the last roasting, to drive off the excess of sulphur, is dispensed with, so that the sole difference between the two colors appears to be, that the green ultramarine contains more sulphur than the blue. Certain precautions are of course necessary to produce a fine color, which are of interest only to technologists.

The ingredient or ingredients, in the natural and artificial ultramarines, to which the color is to be attributed, is a question which has occupied the attention of several chemists and given rise to considerable discussion, without, however, a definite settlement up to the present time. At first it was attributed to the presence of *sulphuret of iron* formed by the action of the sulphur upon small quantities of iron present in the mass and derived from the materials employed. This hypothesis derived support from the fact that sulphuret of iron may be obtained, by chemical precipitation, diffused through a liquid in excessively small quantity, in such a manner as to impart to the liquid a deep green, or even bluish-green color by transmitted light. This is a phenomenon frequently encountered by chemical analysis. Brunner and others, however, have stated that they have prepared blue ultramarine from materials entirely free from the smallest trace of iron, and if Brunner's authority is received, the coloring matter of ultramarine must be considered a substance *sui generis*, having no analogue whatever among all known chemical compounds, being in fact a compound of sulphur, silicon, aluminum, sodium and oxygen possessed of a blue color, whereas no two more of these five elements are known to form any other compound possessed of the smallest tinge of blue or green color.

On a thorough consideration of the subject, however, the last hypothesis seems hardly credible, and it appears probable that those chemists who have prepared ultramarine from materials free from iron, have accidentally introduced traces of this metal during the process. Thus it is almost impossible for a chemist who knows the affinity of sulphur for iron to suppose that they can coexist in the mass, together with soda, during the process, without the formation of some highly colored compound, and the belief that ultramarine can exist, which is free from iron, involves the necessity of supposing that the highly colored sulphuret of iron existing in ultramarine which *does* contain iron, has little or no effect upon the color. It is certain that some who have tried to obtain a blue-colored mass from materials containing no traces of iron have failed; but such negative results are, of course, of comparatively small value, and on the other side of the question may be brought forward the well known fact that the presence of more than an exceedingly small per centage of iron injures or ruins the color, and also the singular fact, that if potash is substituted for soda, no blue or green color can be produced under any circumstances, the corresponding potash compound being white. This last fact distinctly connects the color with the sodium which is present, while the effect of dilute acids in destroying the color with simultaneous expulsion of a portion of the sulphur in the form of sulphuretted hydrogen, indicates a probable, though not a necessary dependence of the color upon the sulphur. The whole subject, in fact, needs reinvestigation, and may be urged as being decidedly one of the most interesting subjects with which a chemist could occupy himself, and one which promises important practical results.

In conclusion, a few applications of artificial ultramarine may be pointed out which may be seen exemplified in the Exhibition. Thus great quantities of stationery in the American department may be seen, which are undoubtedly colored with ultramarine. Ornamental paper for walls and other purposes, among the colors of which ultramarine forms a prominent ingredient, may be seen in various places. Soaps and leather, colored with ultramarine, are on exhibition. Signs and placards composed of gilt letters, upon an ultramarine ground, are very common. The backs of many of the show-cases are colored with ultramarine, its azure color appearing to be a favorite tint for such backgrounds; and, lastly, it is an important auxiliary in the decoration of the Crystal Palace itself, a light-colored ultramarine having been largely employed in painting the roof and columns, as well as the canvas which covers the interior of the dome.

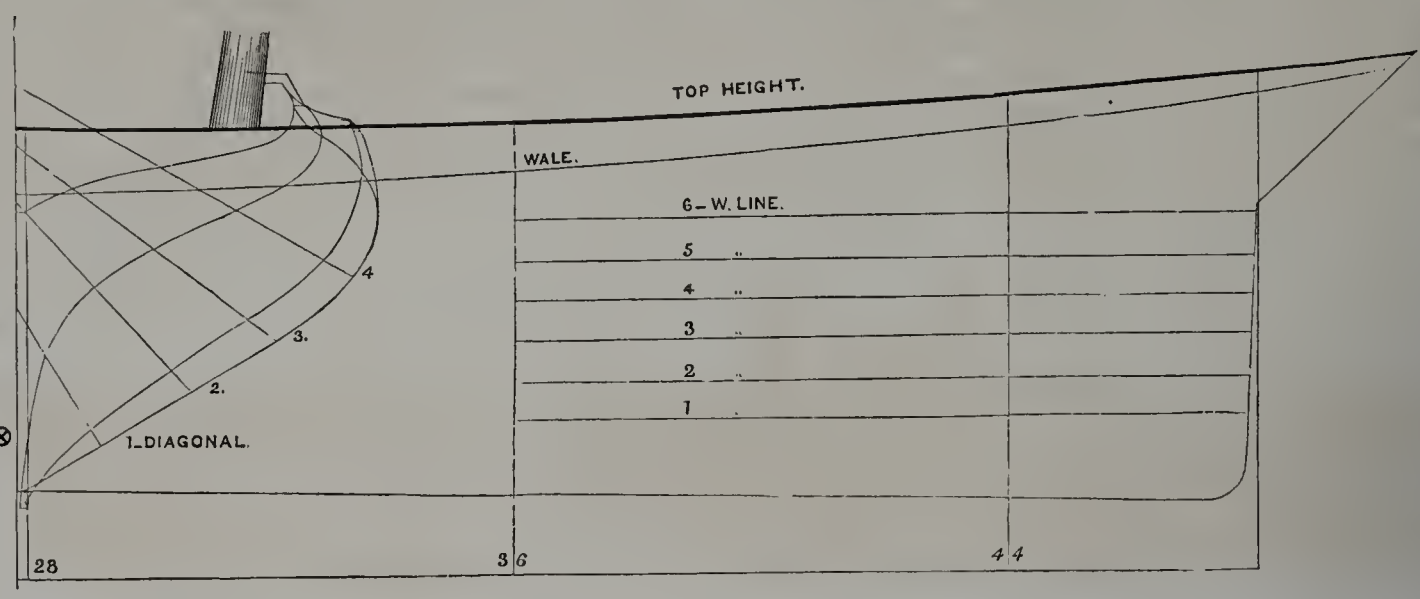
NAVAL ARCHITECTURE.

IT would be foreign to the objects aimed at in the RECORD, to attempt more than a mere popular elucidation of the principles of the science of naval architecture, in which the results of the last few years have established the United States in an eminent position. In the infancy of the republic, a happy preservation of neutrality in the European wars, placed her, in connection with England, then the most powerful maritime nation, in possession of the carrying trade of the world. The English merchantmen were compelled to sail in company, under the protection of a convoy, and the movements of the entire squadron being regulated by those of the dullest sailer, superior qualities of speed were of no benefit, and the skill of her builders was centred upon attaining the greatest possible capacity from the measured dimensions. Her absurd tonnage laws afterwards sustained the evil until the system was too deeply rooted to be readily cast aside; and even at this day, so superior are American ships, that British merchants prefer them as investments, and own a large portion of the stock of the American transatlantic liners and packet ships.

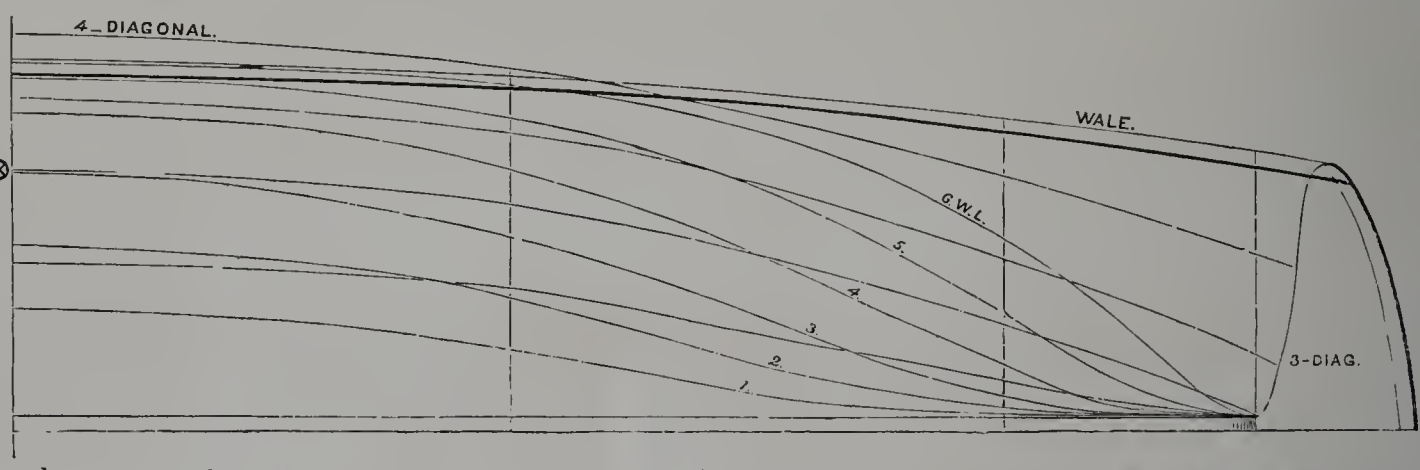
The mathematical solutions of the various problems involved in ship building, are so largely modified by practice, that there is no necessity for following them further than to enable us to establish with certainty the effects of the different proportions, and by experimenting understandingly, avoid a repetition of error, and expand to their fullest extent those principles which may prove advantageous. A convincing demonstration of the solid of least resistance is of little benefit; but while records of mere facts of much less complexity than those involved in this science have proved a facility for error in observation and omission, it becomes necessary to reject all that conflicts with the known laws of natural philosophy, and cautiously receive whatever may not be in accordance with reason. Pure theory is perfect; but, unfortunately, too often becomes so only when the science to which it is applied has been perfected.

With the other dimensions and conditions remaining constant, the immediate effect of length is to decrease the direct resistance of the water to the passage of the hull, and to diminish the leeway and violence of the rolling and pitching motions. As, in the passage of the vessel, a distance corresponding to its length, the water is divided and separated a distance equal to the breadth of the section, it follows that a vessel, 200 feet long, will transmit no more motion in passing 200 feet, than one of half the length will in going half the distance; the longer vessel would displace double the quantity of water, but would communicate to each particle only half the velocity which it would have received from the smaller one; and as fluid resistance varies as the squares of the velocities, the resistance to ships, other things being equal, varies in an inverse ratio with the squares of their lengths. The length being doubled, theoretically considering this element alone, it would require but one quarter of the power. The benefit derived from the superiority of acute angles for cleavage, is practically limited by the friction of the immersed surface and insufficient buoyancy of the ends. The retardation occasioned by the friction of the water has been too generally disregarded, and its importance is only realized by making a calculation on a sea-steamer, where the power is known

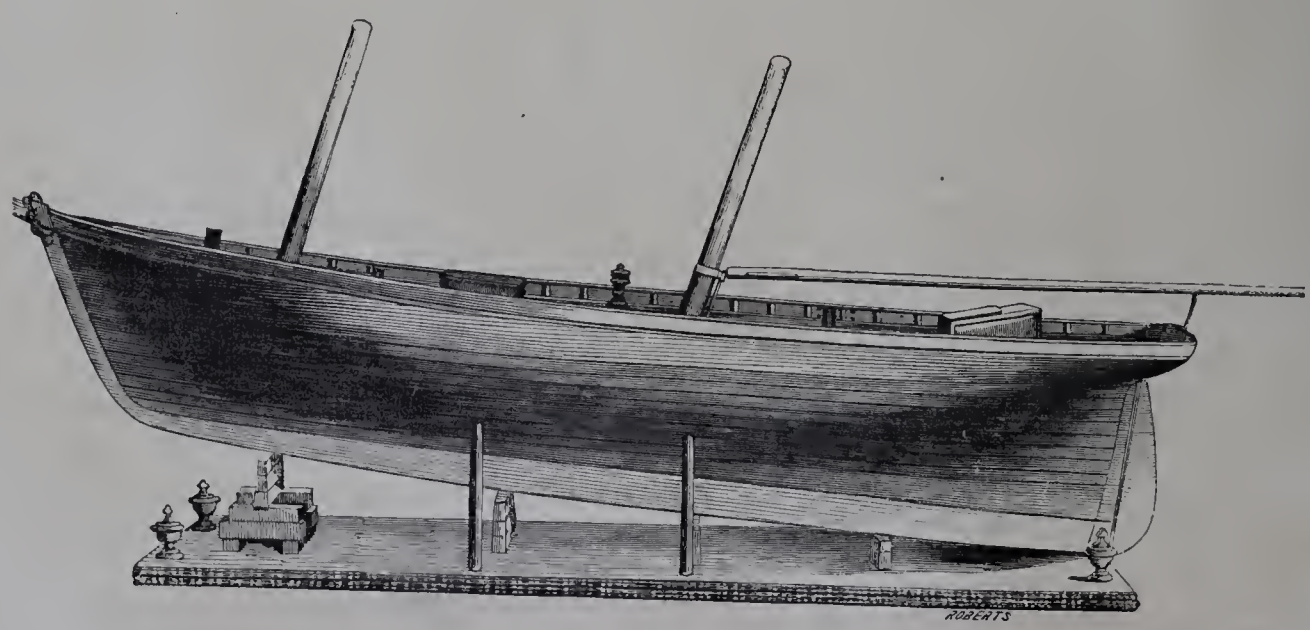
from an indicator, and which will show that nearly one-half the power utilized in propelling the vessels is absorbed by the friction of the water on its immersed surface. The experiments of Col. Beaufoy establish the friction of a square foot of smooth surface moving on the water at the rate of ten feet per second, to be six-tenths of a pound; and at deep immersions it must be greater. The failure of the steamboat Rainbow, built in New-York abont twelve years ago, to make the trips on the Hudson River in some incredibly short time, exemplifies the evil effect of excessive length.



Breadth affects the stability, and when carried to an injurious extent, endangers the safety of the spars; and by enlarging the midship section, increases the direct resistance to motion. It is difficult to upset a shingle, and the excessive breadth giving it this quality, is also the cause of the sluggish motions which admits of its being washed over by every sea. It is highly advantageous for ocean steamers to possess a large amount of buoyancy at the load lines for the purpose of lessening the difference of drafts and variable action of paddle-wheels, which in leaving port deeply immersed, frequently dissipate twenty-five per cent. of the power of the engines in oblique action, and after burning six or eight hundred tons of coal, close the voyage with so little hold on the water, that nearly the whole power is extended in dashing the water backward. In a fast-sailing ship, intended to be weatherly, the draft is determined by the necessity for a hold on the water to prevent leeway: in steamers, and particularly in river steamers, where the power is applied parallel to the keel, and there are fewer disturbing forces acting upon the hull, the depth of hold and draft of water may be made much less.

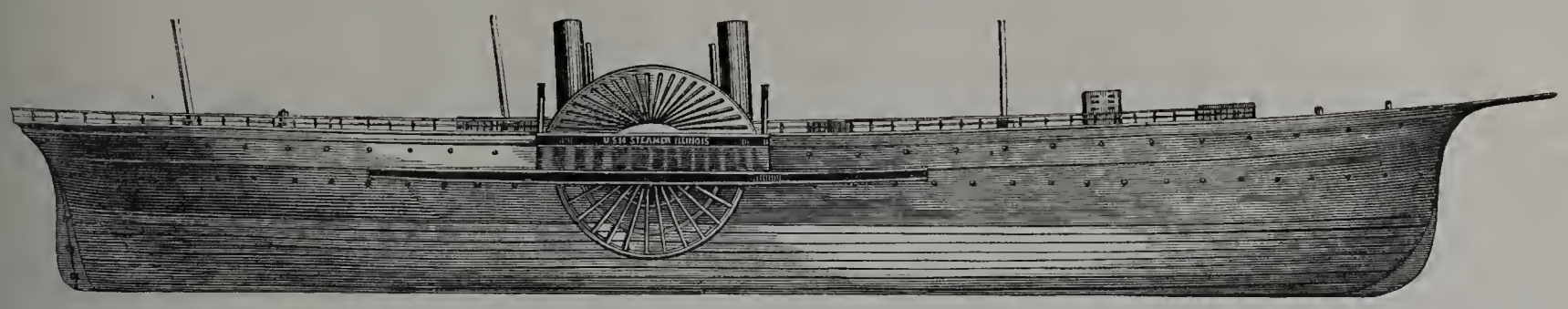


The midship section of a ship is a cross section at its widest part, and as the gradation to the ends is gradual, it represents generally the figure of the body of the ship, and the qualities given by its peculiar shape, determine the character of the vessel. A cylinder floating in the water, has no stability, because the shape of the immersed portion remaining unchanged, the centre of buoyancy, or centre of gravity of the hollow made in the water by the floating body, and in which the whole upward or sustaining force of the water may be supposed to be concentrated, remains in any position of the cylinder in the vertical line passing through its centre of gravity. In a flat, rectangular figure, the centre of buoyancy is directly under the centre of gravity when floating on its side, but when inclined by the application of a force until the water line is no longer parallel to the side, but corresponds with a diagonal of the figure, the centre of buoyancy is one-third of the width from the immersed edge, and operates as the whole weight of the displacement at the end of a lever, whose length is the horizontal distance between a vertical line passing through it and the centre of gravity of the body which remains as before. As this latter figure is difficult of inclination, it will not meet the force of waves by rising readily and quickly, and when the difficulty of motion is overcome, the bearings or limits of inclination are so suddenly reached, that the motion is abruptly checked. Should it be loaded in such a manner, that a vertical line passing through the centre of gravity of the mass falls outside of the centre of buoyancy, the forces of gravity and buoyancy will act in concer and turn the body over until the displace ment becomes such that the two centres are in vertical line. The midship section is shaped with reference to the disturbing force, and should be so nicely adjusted that there is no wide difference between the solid lifted from the water by the rolling of the ship and that immersed by the same process —the preponderance of the latter determining the ease and smoothness with which the vessel recovers her upright position. The greatest breadth is above the load water-line, and there is no very good reason why the sides should fall in or "tumble home" above, as is usually practised. Custom or fashion sanctions it, as it once did the heavy bowsprit, rakish sheer, and overhanging stern, which were deemed essential to at least a shipshape appearance, but are now discarded.



Theoretical considerations alone will warrant the use of hollow lines as the readiest way of moving the opposing water, but friction and other disadvantages attendant upon a long, thin bow, with insufficient buoyancy to support itself, will probably more than compensate for the diminished direct resistance. In the American ocean steamers, the gradual flare and easy rise of the bow, with no superfluous weight, has given them a world-wide reputation for freedom from pitch-

ing and facility in meeting the waves. The same considerations of pitching and 'scending apply to the stern, which should possess the requisite fulness above the water graduated to avoid the occurrence of violent and sudden shocks, and be relieved of all unnecessary weight, which, in such a place, is renderedmore injurious by its leverage. The water filling into the vacuity left by the passage of a vessel, does so with a rapidity proportioned to the pressure or depth, and consequently with a velocity decreasing towards the surface where it should be quiescent. To facilitate this action, the upper water-lines require to be full, and the lower ones finely tapered, so that the diagonal lines representiug the probable course of the



water, have a quick ascent from the keel and approach the horizontal at the surface. It was found that the steamboat John Neilson, which has a peculiar flat floor gradually rising aft, for the purpose of retaining a stratum of air pumped under her bottom to lessen its friction, is improved by an application of false stern in conformity with the principle above recorded; which is not a generally recognized one, although carried out to some extent iu the yacht America, and other recently modelled clippers. By the courtesy of her modeller, George Steers, Esq., we are enabled to furnish a drawing of the after-body of the "America," exemplifying the various water lines and diagonals used in the draught of a ship.

The calculations of the size and position of the sails require a knowledge merely of the simple problems of resolution and composition of forces, and may be easily examined in detail; but, as in those of the hull, although the abstract principles are simple when examined singly, their combination to produce the desired result involves a sagacity and powers of observation, analysis, and application, not surpassed in any other profession, and not at all lessened by the fact that they are not made to apply to particular circumstances, but must correspond to the varying requirements of trade and travel frequently involving an antagonism of principles. Take, for instance, the consideration of steering qualities:— It is desirable on account of safety that a vessel should carry a weather-helm to counteract a tendency to come nearer the wind, and there is no doubt but it materially assists the progress of the vessel by diminishing the leeway; but when the sails and hull are so badly adapted, that they require a constant and material corrective action of the helm, the retarding effect of the rudder must be very considerable.

A model of the pilot boat Enchantress, by D. D. Westervelt, is the best in the Exhibition to illustrate the steering qualities of a ship. With a light, buoyant bow to rise readily over the waves, and a deep, lean stern, she will steer easily and quick, but require a ready eye and hand to meet the seas on either bow, which would cause her to fall from her course. A great difference in the draft forward and aft, is objectionable on account of the necessity for deep water, but is necessary in vessels of this class to counteract the effect of the preponderating after sails.

A beautifully executed model of the clipper-ship, N. B. Palmer, as constructed by Jacob A. Westervelt & Co., shows the disposition of the timber and bracing, and forms a complete study. If a ship were divided in its length into a number of sections, those in the middle would rise, and at the ends would sink from the common level, producing the effect termed "hogging:" again, when a ship is heeled in a wind, the action of the water on the inclined surface of the bow occasions a lateral curvature, amounting, in an English man-of-war, where provision was made for observing with accuracy, to a departure of one inch and a half from a straight line, or a variation of three iuches on the two tacks. These, and various other strains, and the necessity for discarding useless material, require a scientific disposition of timber. The tendency to hogging is guarded against by solid floors to resist the compression below, and direct connections above, extending the whole length, to sustain the tension which obtains there as in a beam loaded at the ends and supported in the middle. The iron braces which are frequently used to strengthen the hull, and when double form a lattice work crossing on the sides at right angles, might be more advantageously disposed as an arch springing from the unsupported ends and rising as high as possible amidships.

Clipper ship *Whirlwind*, modelled by Robert Uuderhill. Length 200 feet; breadth 40 feet and depth 20 feet. Clipper ship *Vision*, of 750 tous custom-house measurement. Length on deck, 150 feet; moulded breadth of beam, 32 feet 4 inches, and depth 20 feet; modelled by Ananias Dekke, of Boston. The "Vision" has full water-lines aft, but is also full below, and is in this respect inferior to the "Whirlwind." The latter has steamboat ends, and being proportionably longer, has more acute angles.

U. S. Mail Steamer Illinois, built by Smith & Dimon. The midship section of this model is placed aft the middle of the length, and it is likely the body would be improved by shifting a portiou of the buoyancy at the foremast to about the mizen. She has something of the English full after-body, but not carried out so completely as in the "Georgia" by the same builders, and would be more easily steered and propelled had the rise of the lower after-lines been earlier commenced

There is also a model of a steamship proposed by Darius Davidson, which demands attention, on account of the magnitude of its dimensions. The length of keel is 700 feet, and of deck 500 feet; beam 80 feet, and depth 60 feet. It is to be propelled by sixteen engines, indicated in the model by eight sets of smoke pipes placed along the deck; and her time in crossing the Atlantic, it is anticipated by the sanguine Mr. Davidson, will be inside of five days. The pointed ends, projecting 100 feet from the body of the hull, would make capital adjuncts to a machine for diving purposes. A false bow, similar to the above, was tried on the steamboat Albany, in 1838, and discarded.

William A. Sillen exhibits a good model of a ship, to which he has attached a card, stating that having discovered a diversity of opinions as to the proper shape for insuring the desired sea-going qualities in a ship, he concluded there was some mistake in the ordinary theory, and was led to institute a series of peculiar experiments, by which (*mirabile dictu*) he was convinced that the water does not pass along the ship's sides and bottom in lines parallel to the surface. Diagonals, or proving lines, have been employed in laying down a ship's lines ever since drawings were used in their construction.

Proposed plan for a yacht Petrel, by F. S. Copley. At the load water-line this vessel will possess no stability, and the motion easily induced will abruptly cease on the immersion of the broad, flaring side to leeward. Place her in an inclined position, and the motion of the water upward and backward, passing under its surface around the angles and irregularities, will be very varied, and, as may be readily conceived, not particularly conducive to speed. The double keel will not oppose twice the resistance of a single one to leeway, but will offer its full proportion of friction. A keel, at any rate, is of no use in running with a free wind, and when on the wind a centre-board will answer the purpose equally well, and may be raised or lowered to suit the varying requirements. Small vessels may be made as strong without them, and the handling of the weight, with the assistance of counterbalance springs, as applied in the yacht Maria, is a very simple matter. The U. S. Schooner Onkahye had a section similar to that of the "Petre," (with the exception of the double keel), and was indebted to it for constantly endangering her spars and ultimate loss by capsizing.

The French department of the Exhibition contains a model of a steamer propelled by submerged wheels, precisely similar to those known in this country as Hunter's patent. A pair of ordinary radial wheels are placed horizontally in the vessel below the water-line, with the paddles projecting from the sides. Restricted as they necessarily are in size, an engineer would at once anticipate an enormous slip, amounting, in the applications of this plan, made by the United States Government, to about fifty per cent. Even to the most unprofessional, one would think this proposition of carrying wheels and wheel houses (the latter, moreover, filled with water) inside the hold of the vessel, would be preposterous.

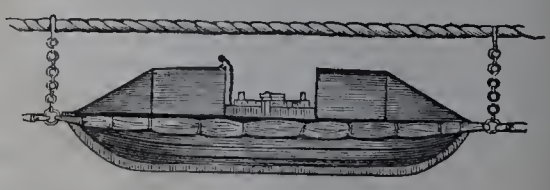
LIFE-BOATS.

IN consequence of the exertions of the National Shipwreck Institution of Great Britain, much attention has there been devoted to the subject of life-boats; and a collection of the best, comprising no less than fifty-four specimens selected and contributed by the Duke of Northumberland, the President of the Institution, formed one of the prominent features of the London Exhibition. The encouragement of these valuable productions, furnished by the private munificence of the distinguished President, was so splendid an example of liberality in the cause of humanity and practical science, that the jury having cognizance of the subject, reported him worthy of a Council Medal. The importance of the subject will be recognized without a statistical exhibit here of the numerous shipwrecks and frightful loss of life, which it is too frequently the duty of the daily journals to record. The Steamboat Law, passed by Act of Congress, on the 30th of August, 1852, provides that every steamer shall carry a number of life-boats, proportionate to her size, amounting in the case of a vessel exceeding fifteen hundred tons to six; and a number of life preservers otherwise specified.

Besides the buoyancy requisite to carry a heavy load of passengers with its crew, a life-boat should be formed to pull easily and be readily managed, and in the event of being upset, should be able to right itself. A sad experience has shown in more than one instance that the want of this last quality may occasion the loss of a brave crew. The form best adapted for the purposes of a boat to be chiefly employed under the exigencies of a storm in which ordinary boats are unable to live, is that usually given to whale-boats, but with more breadth of beam to furnish the stability required by the incautious movements of frightened passengers, and the necessity for rescuing them from the water and dragging them in over the gunwale. That this valuable property may, however, be carried to excess, seems to be demonstrated by several recorded instances of life-boats having a proportion of beam, exceeding one-third of the length, in conjunction probably with full terminations, being turned end over end in a heavy sea. To enable a boat to right itself when upset, it should be ballasted along the bottom, and have air-tanks at the ends carried up as high as practicable by sheer of gunwale. Water ballasting to be admitted at pleasure, has been used in a tank extending along the keel; and although the attainable variation in weight of ballast is useful when under sail, at which time, however, the unemployed men may sit to windward and answer the same purpose, yet, in more ordinary circumstances, and particularly at the moment of launching, when accidents are very likely to occur, the advantages of permanent ballast are superior to those attendant on that which can only be taken in when the boat is afloat, and the chief merit of which lies in the diminished weight for transportation ashore. Probably the best manner of ballasting a boat is to give the bottom an inner lining of common cork, covered by an ordinary flat floor; thus reducing the internal capacity and enabling it to rise when swamped under a sea, and still sufficiently heavy to insure stability. With the buoyancy occasioned by the use of air-tanks, a boat heavily laden and filled with water may be able to swim, and, indeed, rise a few inches above the surface of the water: now, if in this latter case, there was an outlet or hole in the bottom of the boat, the water inside and outside would endeavor to reach a common level, and that inside would run out, and the boat being lightened, would continue to rise until the general buoyancy and weight corresponded—self-acting valves opening outwards, therefore, are valuable adjuncts to a life-boat.

The Act of Congress, which has been referred to, specifies that the life-boats must be made of metal. Where a wooden boat would be crushed amid the fragments of a wreck, or stove by a projecting rock, a metal one will escape with an indentation which may be easily repaired, and at any rate interferes but little with its useful properties. In the case of fire they are pre-eminently superior. Their tightness, freedom from worms, and immunity from warping by exposure to the sun, has occasioned the employment of metal as the chief material of construction, to be regarded as one of the prime elements of a life-boat. A wooden Whitehall boat, built and exhibited by one of the best builders in New-York, illustrates the superiority of metal as a material. During the short time which has elapsed since it was placed in the Exhibition, the dryness of the atmosphere has already sprung several of the planks and fastenings and opened some of the seams.

Francis' Life-Boat.—It is to be regretted that the owners of Francis' patent, who have manufactured over twenty-five hundred metallic boats, have not exhibited a fair specimen of their life-boats—considering the term in its definite meaning and *per se*. The one furnished is a copper, man-of-war-cutter, thirty-one feet long, of the ordinary model, and furnished with air-tanks at the ends. The chief and most valuable peculiarity is the corrugations of the metal, resembling externally a clinker-built boat, and materially enhancing the strength with but little addition to the weight. The sheets of which the boat is formed, are struck into shape between dies operated by a hydraulic press, and the variations from the original plane superfices are chiefly taken up by the corrugations. The great increase of strength is exemplified by the exhibition of examples of similar sheets, in which the corrugated one supports a heavy load without appreciable flexure, and the other and plain one sinks under its own weight. Galvanized iron is cheaper, but slightly inferior to copper, and is more generally used.



In storms of such violence, that it is impossible to manage a boat, communication may be instituted between the shore and a wreck, by means of a hawser drifted ashore by a barrel, or thrown from the shore with the assistance of a rocket or a ball. On this hawser a close car, conveying passengers, represented in the accompanying drawing, may be traversed backward and forward by the lines attached to its ends.

Lewis Raymond, of New-York, furnishes a galvanized iron life-boat, of the whale-boat model, with air-tanks at the ends and along the sides, and fitted with self-acting bailing valves, the uses and advantages of which have been adverted to.

In the English department is exhibited a model of an iron boat, or car, with no name attached. It has no rowlocks or thole pins, and is shaped like a car without a top. Its distinguishing peculiarity is an arrangement of buoyant fenders placed on each side, about the width of the boat distant from it, and nearly equal to its length—they are placed on a flexible beam fastened to stanchions extending to the boat, the centre one of which is stationary, and the end ones allowed to slip into recesses or cases built in the boat and extending under its seats.

The three groups of STATUETTES in terra cotta, are exhibited by ANDREA BONI, some of whose contributions have been given on previous pages of the RECORD.

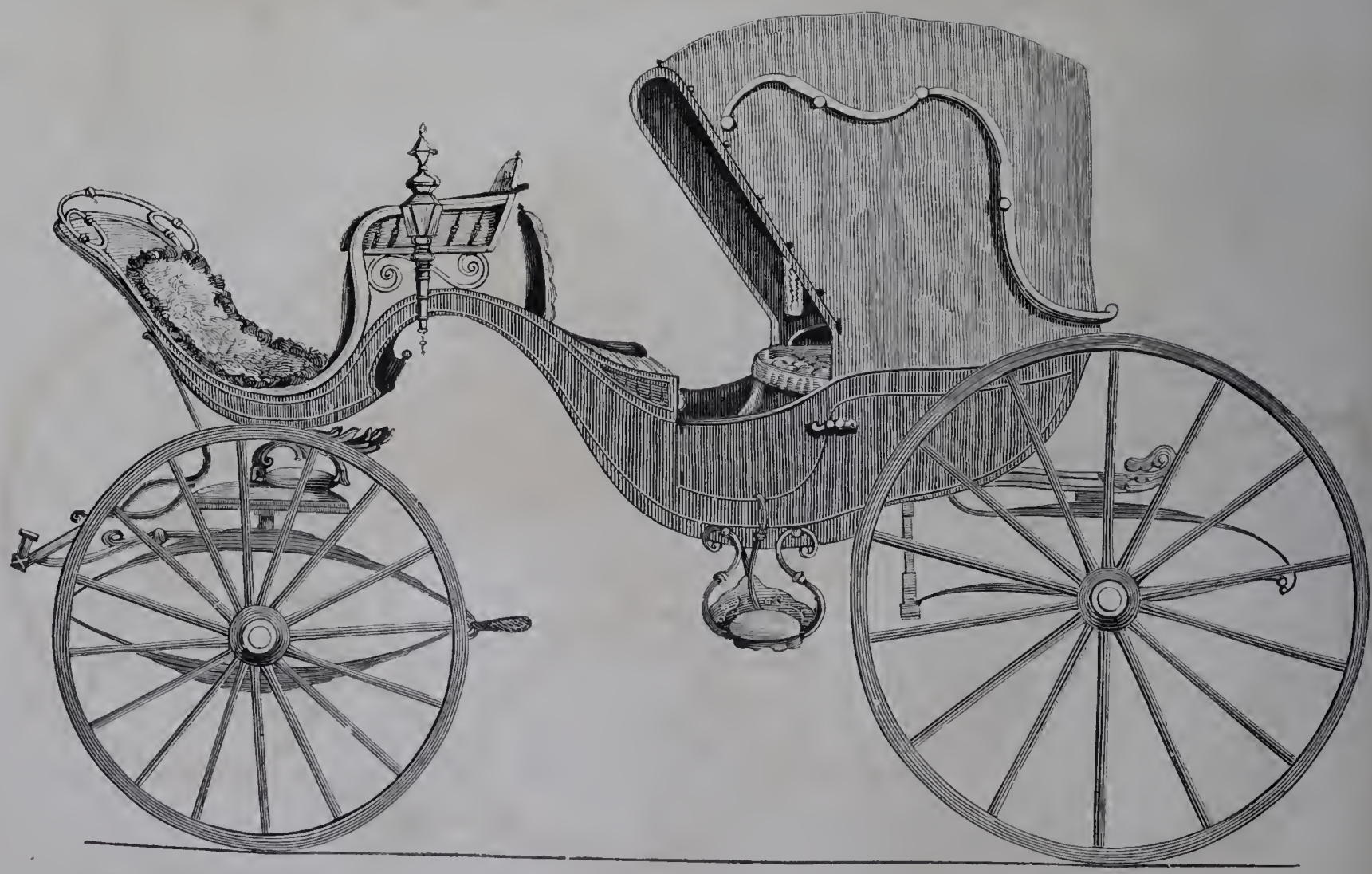
The famous antique vase, known as the WARWICK VASE, is a favorite subject among artists, if we may judge by the numbers reproduced in bronze, terra cotta, parian, &c., which meet one in every quarter of the Exhibition. The one which we engrave is of large size, sculptured in marble by NICOLA MARCHETTI, of Carrara.

The FISHER BOY of POWERS, inadequately represented in our engraving, is not, in our judgment, a rival of the statues that stand near it, the Eve and the Greek Slave, and falls far short of the admirable truth and beauty of the busts, in which our great sculptor is confessedly unrivalled. The sentiment of the statue is expressed in those finest lines of Landor, describing the murmuring shell:

Then apply
Its polished lips to your attentive ear,
And it remembers its august abodes,
And murmurs as the ocean murmurs there.

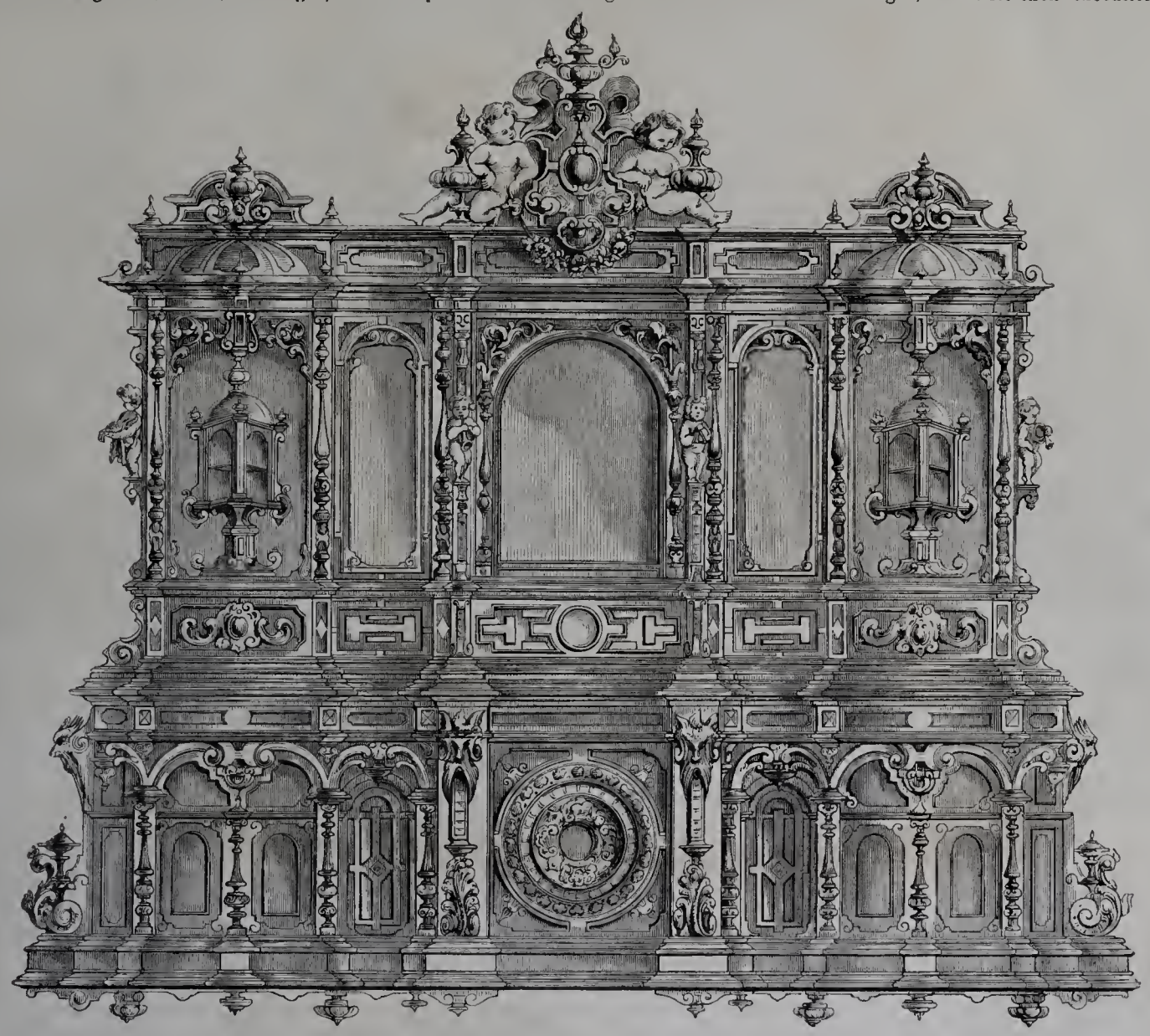
The Fisher Boy is exhibited by SIDNEY BROOKS, Esq.

The group of sculpture with which this page commences, is exhibited by L. Caselli, of Florence. It is entitled Hagar and Ishmael, and the circumstances of the scene chosen by the artist, are well known in the simple narrative of the Scriptures. The boy, weary and exhausted by unaccustomed hardships, has sunk down in the desert to die; but Hagar, sustained by the measureless affection of a mother's heart, supports the fainting form of her son, and seeming to have just put aside the cup now drained of its last, precious drops of water, she gazes upon his face, while in her own, hope still lingers, before yielding to the unutterable anguish of despair.

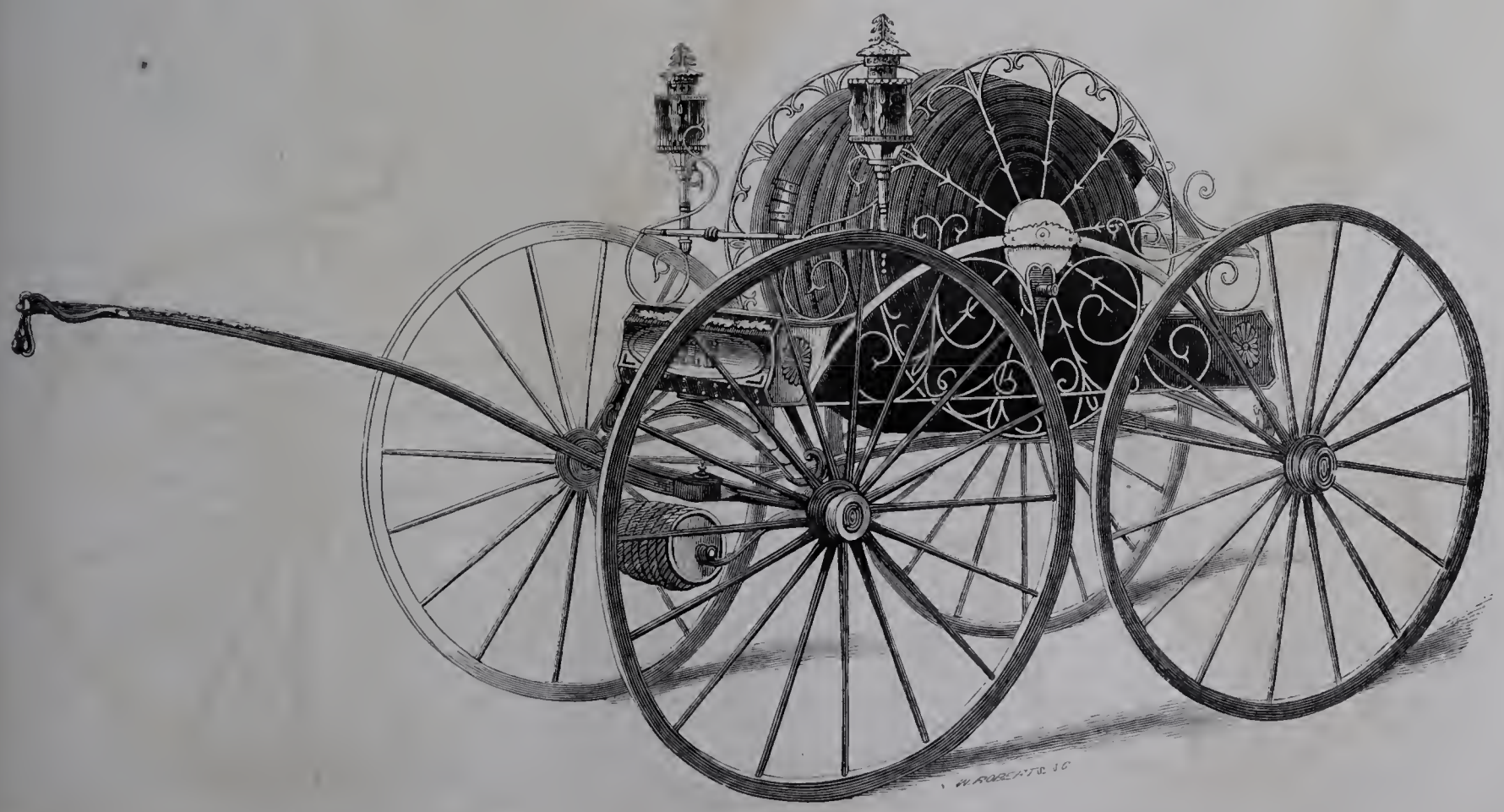


In the manufacture of carriages our countrymen have succeeded better than any other nation, in combining the essential qualities of lightness, beauty, and strength. The large and elaborately finished Pleasure Carriage, engraved here, comes from the manufactory of Messrs. Lawrence & Bradley, of New Haven, Conn. It is lined with blue velvet, and in construction and finish, sustains the reputation acquired by the manufacturers of that city.

In the American department of the Exhibition, we have been agreeably surprised to find a number of pieces of ornamental furniture of large size, which, in design and elaborate and excellent workmanship, are entirely creditable to the exhibitors, and compare on equal terms with the productions of foreign manufactories. It is true that many, and perhaps all of these, have been indebted to persons not American born for the artistic designs, if not for their execution; but we may partly



claim the talent which is naturalised among us, and the fact that such costly and beautiful articles are executed at all, shows that there is a progressive development of taste in the minds of our citizens, corresponding to their increasing wealth. The ETAGERE, which has served as the occasion of these remarks is carved in rosewood. It is exhibited by T. BROOKS, of Brooklyn, N. Y. It was designed by G. HERTER, New-York, of whose artistic designs we shall soon have occasion to speak again.



We engrave the CITY HOSE CARRIAGE, No. 8. built by PINE & HARTSHORN. About a score of the mechanics of New-York, whose names are set forth on the attached card as having aided in designing, constructing, or decorating this beautiful carriage, we have not room to enumerate here; and still less have we space to describe the details of their admirable work, well shown in our engraving. The carriage is an ornament to the city, and an honor to the company.

We introduce this page with three illustrations of ivory carved work, a branch of art manufacture which is cultivated with success in many places on the Continent. These specimens come from Darmstadt, and are contributed by J. H. Friedrich. They are two Tankards and a Cup, all of them lined with brass, and thus adapted to use. The carving is executed with spirit and fidelity. The tankard on the left represents a forest with deer; the one opposite, a stag-hunt, with the noble animal at bay; and the cup bears an Alpine declivity, with its tall firs and a herd of chamois.

The remaining illustrations of this page, and two which commence the opposite one, have been selected from the contributions of Messrs John Rose & Co., the eminent manufacturers of Coalbrook Dale, Shropshire.

The Porcelain Vase on the left we can notice only to condemn. It is a deliberate violation of those principles of decorative art which have been arrived at by the experience of ages in ceramic manufactures. It could only be tolerated by those who prefer novelty to beauty of form, fitness, and every other merit.

A small Parian Bracket, which follows, in the Raffaelesque style, is a work in which beauty and propriety

equally appear. We heartily wish that this fine material (Parian) had been altogether confined to purely ornamental objects like this, in which it admirably fulfils every requirement, instead of being misapplied to ordinary table furniture, as has been done in the Tea Service, which, except for this fault, would be unexceptionable. The fine granular surface of Parian has a positive attraction for dirt, and we like not to be compelled to remember the inevitable impurities of Parian tea-cups, butter-dishes, and beer-jugs, in connection with the divine creations of art, fitly enshrined in the same material.

The beautiful porcelain vase, called the QUEEN'S PATTERN VASE, is modelled after the original in the possession of her majesty. It is entirely creditable to the taste and skill of the manufacturers, and forms one of the chief attractions in the display of Messrs. Rose.

ANDREA BONI, of Milan, many of whose productions have been already noticed in the RECORD, exhibits also

the CHIMNEY PIECE in terra cotta, noticeable for good workmanship and general excellence of design.

The two small STATUETTES in Parian, and the PITCHER

and CANDLESTICK in the same material, are exhibited by

Messrs. T. & R. BOOTE, of Burslem, Staffordshire.

Messrs. W. & J. Sangster, Regent-street, London, have achieved and merited a reputation for the excellence of their Parasols and Umbrellas. A prize medal awarded at the Exhibition of 1851, testifies to their merit. We are, however, only concerned with the ornamental part of their productions—the Carved Ivory Handles, of which we engrave four, on this and the opposite page. Many of these are grotesque and amusing, and all evince much taste, and are well sculptured.

Other examples of good taste and excellent carving, are presented in the two Fire Screens, illustrated on these pages of the Record. They are contributed by Jeremiah Fox, wood carver, of Lynn, England. The stands and frames are highly ornamental, and the screens are in Berlin worsted work.

A massive Chair for the library is exhibited by G. Zora, of Turin, Sardinia. The decorations are in the Grecian style, and are almost entirely overlaid with gilding. It has a very rich appearance.

The remaining four illustrations of these pages represent the contributions of Pierre Adrien Graillon, of Dieppe (Seine Inferieure). They are placed in the Exhi-

bition near the Sèvres porcelain, and they are worthy of that honorable position. These groups in terra cotta, simple as they are, and representing only French peasants, exhibit the genius of the sculptor, as well as

Graillon, and produce effects, pathetic or humorous, which other artists have perpetuated in marble or on canvass. The true artist, however, will make himself felt, whatever material he may choose in

which to render his thoughts, and whether his efforts rank among the productions of high, or decorative art.

A particular account of these groups which so well explain themselves, would be merely an impertinence. We leave them to the admiration of our readers.

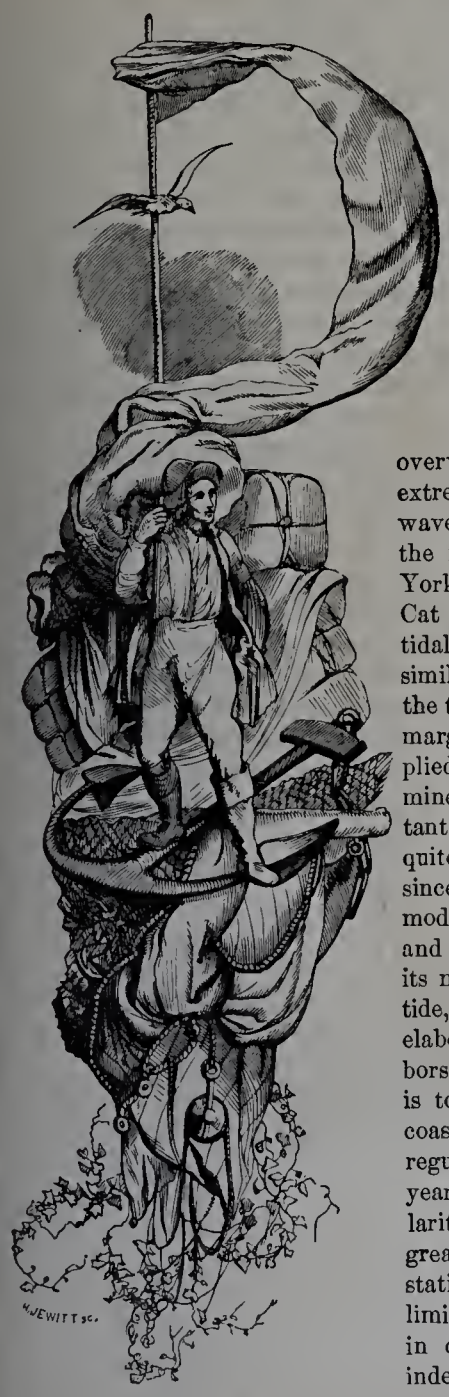
high constructive skill and mastery over the materials of art. A few lumps of clay pass through the transforming hands of

The first engraving upon this page represents a circular plateau of porcelain, exhibited by W. T. Copeland. It is designed for a Table Top. The decoration, which, to some extent, has the effect of a mosaic, is in the Etruscan style. The geometric forms which surround the central design have a pleasing effect, which is enhanced by the

contrasts of the primitive colors in which they are executed. The exquisite beauty of the Florentine Mosaic Table, by Francesco Betti cannot be represented by any engraving. Scarcely more than form can be thus given, while the richness and harmony of the colors, and the labor, skill, and refined taste employed in selecting, fitting, and polishing the immense number of gems and ornamental stones of the mosaic, entirely escape notice.

Among the pseudo-gems in this design we notice amethyst, lapis-lazuli, cornelian, &c. For further information relating to this interesting branch of art-manufacture, we refer the reader to our essay on Mosaics.

TIDES AND TIDE GAUGES.

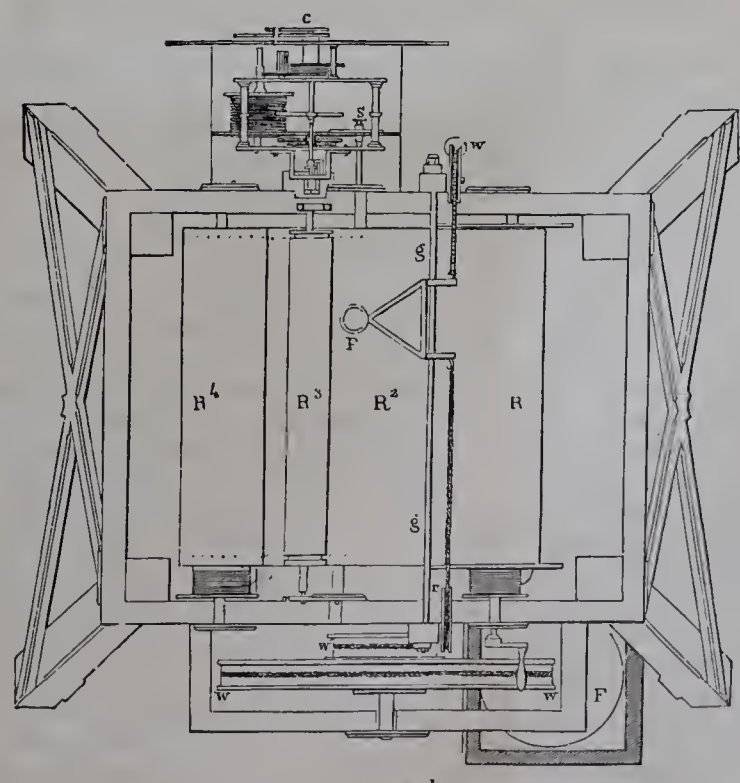


ETERMINATIONS of the phenomena of tides form an important part of the system of operations pursued in conducting the United States Coast Survey. The extensive hydrographic labors requisite to prepare thoroughly accurate and reliable charts of our seacoast and harbors, would be exceedingly incomplete, if a careful observation and study of the tides did not make an integral and systematic portion of the plan pursued. Our coast presents a wide diversity of tidal phenomena, from the overwhelming rush of waters at the northern extremity of Maine, to the almost insensible wave at some points of the Gulf Coast; from the regnlar and obvious periodicity of New-York Bay tides, to the single daily tides of Cat Island, and the imperfectly explained tidal anomalies of our Pacific Coast. So dissimilar are the characteristics and amounts of the tidal wave from point to point along our sea margins, that observations require to be multiplied so as to include not merely a few prominent points along shore, but all the important rivers, roads and harbors. It would be quite nnsafe to interpolate tidal characteristics, since each locality produces its own special modifications on the great general tide wave, and requires a particular determination of its mean, greatest and least rise and fall of tide, and of its establishment. But as the most elaborate tidal study cannot be given to all harbors or important localities, the plan pursued is to select some principal points along the coast for permanent tide stations, at which regular observations are made through several years, so as to give in full detail the irregularities, with long intervals, and all the facts, great or small, of the tidal rise and fall. Other stations are occnpied with tide gauges for limited periods of one or more lunations, either in connection with the sounding parties or independently, and the tidal characteristics are thence deduced approximately. A set of observations not covering at least one complete lunation, is insufficient for a strictly reliable result, though sounding parties are sometimes, especially in hydrographic reconnaissances, compelled to be content with the observations of a few days, from which the remainder of the tidal cycle is deduced by reduction and discussion, as well as is practicable. Tidal observations must, of course, be regnlarly made during all sounding operations, and the soundings mnst in turn be reduced to the standard plane of reference by their aid. The level of mean low water as deduced from all the observations made, is the plane of reference which is now generally employed, and to which the soundings made during various periods of the tide are reduced. When it is borne in mind that near two and half millions of soundings have been already made in the Coast Survey, the immense labor of reducing all of these to standard planes, and of deducing these planes themselves, can be partly conceived. A casual inspection of the tide table which will be found on each finished chart, gives but a most inadeqnate idea of the great amount of observation and discussion, which have yielded their pith in this laconic epitome.

There is a department of tidal discussion of far higher character than the more directly practical operations of deducing a mean low-water plane, and of referring to it the varions tide phases, &c., in which the construction of particular tide tables consists. These higher discussions have for their object, the analysis and explanation of the phenomena of tides in different localities, by reference to the general physical theory of tides, and the formulæ derived from it. Not only are the main tidal movements direct consequences of the inequalities of the solar and lunar attractions on the different portions of the oceanic mass, but the local traits of tides are, to a great extent, deducible from the application of the general theory to specific cases. Prof. Bache has applied himself with eminent success to this class of discussions, and from the seemingly anomalous cases of single-day tides at Cat Island and Mobile Point in the Gulf of Mexico, and of irregular recurrences at Key West, he has derived a striking confirmation of the physical foundation on which both the equilibrium and dynamic theories of tides ultimately rest. By assigning to the several disturbing causes their appropriate amounts of effect, there results as shown in his discussions, a compound or aggregate effect, which coincides very closely throughout with the complex variations actually observed. These discussions, as presented through proportional or expository curves, are models of their kind, and exhibit the most advanced condition of tidal interpretation. The physical theory of tides, like all undulatory theories, is full of mathematical difficulty, and demands a good proficiency in analysis even for its comprehension, and still more for its expansion; hence its exposition can never be both thorough and popular. To this difficulty inherent in the subject, we may ascribe the not infrequent lack of faith in its truth and completeness, observable in those to whom thorough mental discipline has been denied. The complication of physical elements entering the general tide problem, and of local elements belonging to each case of a harbor, make it quite impossible for any but a well trained mathematical and physical reasoner to do justice to a subject so profoundly difficult.

The usual method of observing tides is by means of a simple tide gauge. This consists of a long vertical box, sunk to the requisite depth in the water, and so firmly attached to some solid support as not to be moved by waves or other disturbing forces. A copper box float made air tight, and of a size just to play freely in the long box, supports a graduated vertical staff, which rises and falls with the float, so as to be read through an accessible door in the side of the box. Some small holes at the bottom of the box admit the water slowly, so as just to neutralize the effect of waves in causing oscillation of the float and staff. Hourly readings during the day and careful observations at the times of slack water are then regularly made and recorded, notes being also taken of the winds and weather. It will be seen that this method is by no means free from objections. It only gives a small number of readings, leaving the remainder to be interpolated. It involves much labor and watching in proportion to the results attained, and readings are not unfrequently lost or out of time, and even in some cases are not faithfully recorded. It involves many chances of error in the readings and records. The observations near high and low water, the most critical and valuable of all, are peculiarly liable to imperfection as the rate of rise and fall is there so small. For most ordinary purposes, this simple gauge is fully adequate, if read with care and skill. But in the refined and long-continued observations requisite for all thorough and elaborate discussions, a continuous and automatic record is highly desirable, if not positively necessary. Every tidal observer has not the minute accuracy and great faithfulness of Gustavus Wurdeman, to whom the survey is so much indebted for his observations on the Gulf Coast.

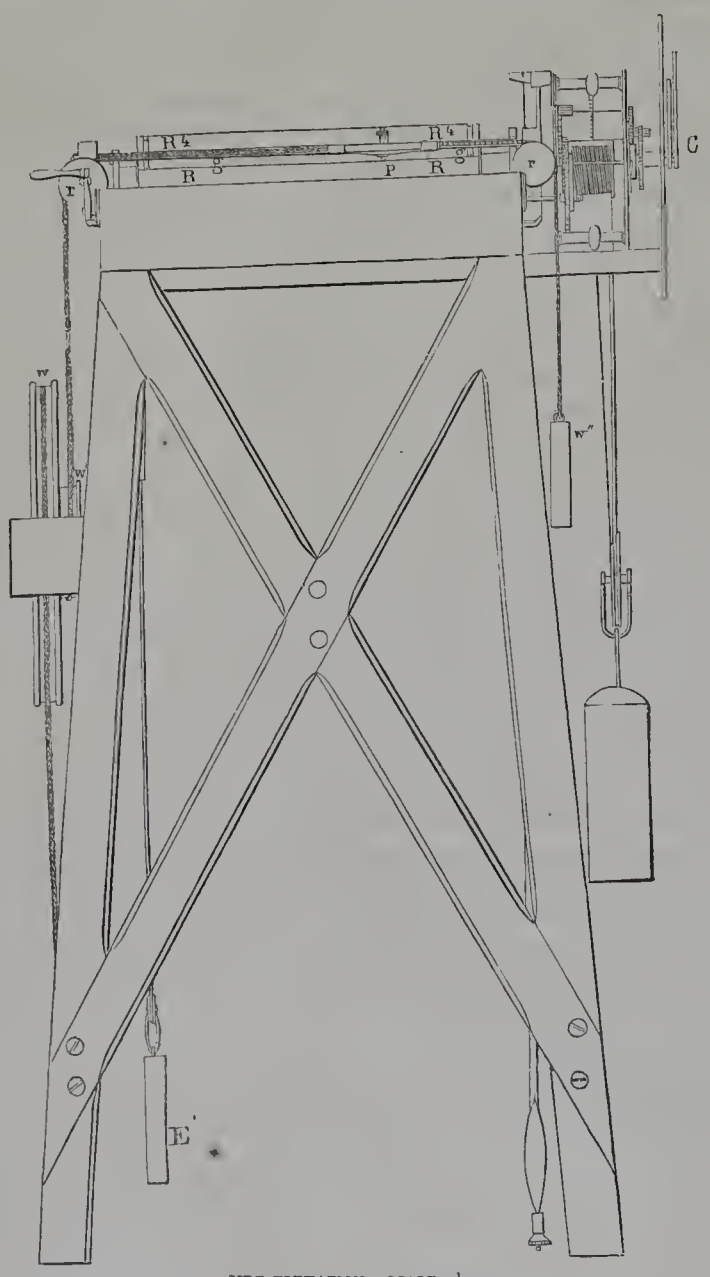
To serve this purpose, and to afford all the advantages of a continuous and self-producing record, the *Self-Registering Tide Gauge*, of which a specimen (U. S. C. S., No. 14) is exhibited at the Crystal Palace, was devised and executed by Mr. Joseph Saxton, the head of the Instrumental Department in the Coast Survey Office. This gauge has been fully tested and approved by the experience of about eighteen months, in different localities with several gauges. Six have been distributed at stations along the Atlantic Coast, and six have been sent under the



PLAN. SCALE=⅛.

charge of Lieut. W. P. Trowbridge, United States Corps of Engineers, and Assistant United States Coast Survey, to record the tidal variations at three permanent and three movable stations along our Pacific Coast. In general terms, this tide gauge is arranged so as to record by a clock movement, the ordinate of time, by points pricked along the length of a running sheet of paper, carried forward by

the clock work, and intended for one month's record. The ordinate of tide height is recorded by connecting the recording pencil with a freely moving float, and so gearing down the float motion as to limit the pencil movements to within one foot or the width of the sheet. A record curve results from these two movements which presents a perfect picture of the daily tide waves, in a series of maximum



SIDE ELEVATION. SCALE=$\frac{1}{5}$.

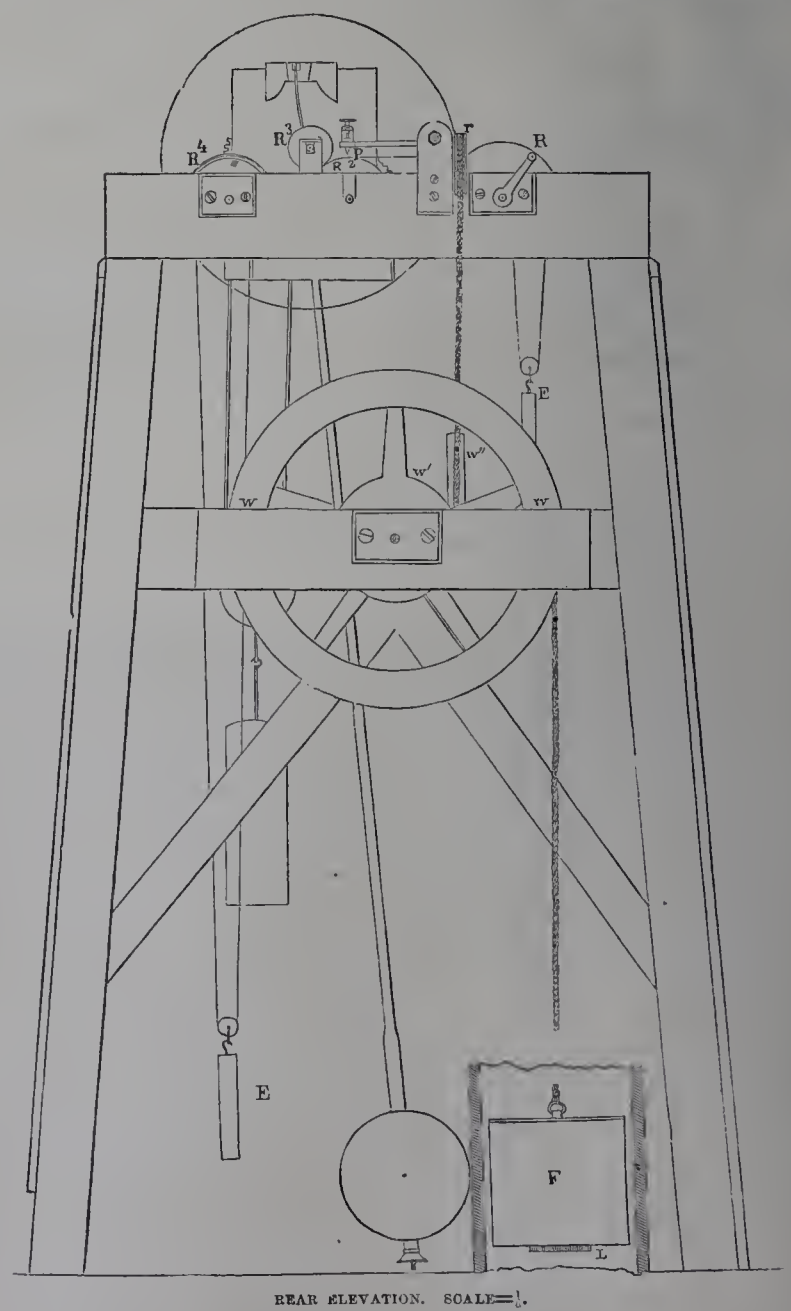
and minimum heights. By applying a reading scale, the actual tide height at any moment can be read off with nice accuracy. As we wish to give thorough and exact information, such as might serve for the construction and use of this instrument, we introduce the following description and drawings, with practical directions derived with slight modifications from official sources.

A float (F) rising and falling with the tide, is connected by means of a chain or wire with a pencil point (p) sliding on a straight guide (g). If a strip of paper be moved beneath the pencil point at a uniform rate, the line will be divergent according to the rate of the tide, and if the paper be marked at regular intervals by the mechanism which impels it, the continuous curved line traced by the pencil will represent the rise and fall of the tide, so that the time and height may be accurately found at any instant. The particulars of the application of this principle are as follows:—The float and wire are protected from the action of the waves and currents by a tube which admits the water freely without allowing oscillation. The float is attached to a fine wire or chain, which connects it with the wheel (w) upon the circumference of which it winds, and another small chain continues from the small pulley (w') on the same shaft, and passing over the friction roller (r) is hooked to the pencil frame. This small pulley reduces the play of the pencil to prevent an inconvenient width of paper, and is regulated by the amount of rise and fall of the tide.

To the other end of the pencil frame is attached a counterpoise (w'') passing over a roller in the same manner. This weight causes the pencil to return as the float rises. The recording paper, being then wound compactly and accurately upon the cylinder (R), passes beneath the pencil point and over the impelling cylinder (R^2) geared to the hour wheel of a time-keeper. This cylinder has at its extremities, and with one foot interval, two circles of twenty-four equidistant conical points to each, arranged on its circumference, and as it revolves once in twelve hours, the points successively pierce and leave the paper at intervals of half an hour, at the same time that the paper passes over, and is re-wrapped upon the cylinder (R^4). To insure the entrance of the points, a small roller (R^5) rests upon the impelling cylinder, and prevents the paper from being lifted. The roller is grooved near the extremities, so that the conical points may not come in contact with the wood. The cylinder (R^4) is urged forward by the weight E', and the cylinder R is held back by the smaller weight E, so that the paper may constantly be kept well stretched. The excess of the weight E' over E is sufficient to overcome the friction of the system of rollers, so that the clock has merely to regulate time. Upon the axle of the impelling cylinder is a clamp screw (S), by which it may be detached from the clock. To put the machinery in motion, the pencil and one of the conical points being brought accurately in the same vertical line at any exact hour, the cylinder is then fastened to the clock by means of the clamp screw, when, as it moves with the clock, it completes a revolution in twelve hours; the conical points will consequently mark exact hours and half hours, whilst the line traced by the pencil will show the corresponding heights of the tides according to the scale to which the machine is adjusted.

The following points require attention in adjusting this gauge :—I. The counterpoise should be rather more than sufficient to balance the chain or wire, taken as they will be, at lowest tide. The strain upon the pencil is very slight, but when the rise and fall is great, the chain or wire should be as fine as possible, that the counterpoise may not be inconveniently heavy. II. The chain or wire to which the float is attached, should be so adjusted upon the large wheel that the curve of rise and fall will be traced on the paper midway between the lines of dots. One or two days' trial will locate this curve of rise and fall sufficiently well for the chain or wire to be permanently pinned. III. A conical point should be brought accurately in a line with the pencil, and the clock started at an exact hour or half hour. IV. That the gauge may be disturbed as little as possible, at least one full month's supply of paper should be wound upon the receiving cylinder at the beginning of the month.

To guard against accidental disturbances and jars, the structure upon which



REAR ELEVATION. SCALE=$\frac{1}{5}$.

the gauge is erected should be as firm as possible. The superstructure for protection against the weather and other disturbing causes, need only be large enough to allow free access for attendance on the gauge. The box for containing the float should be water tight, below water, except an adjustable orifice, which may be made by a series of holes about an eighth of an inch in diameter, covered in

part by a slide, and it should extend up to the floor on which the gauge rests, that the free action of the float and its connecting wire or chain may not be endangered by obstructions falling into the box. Having so adjusted the wire or chain as to give the midway position on the paper to the record curve, particular care should be taken to prevent its being altered, since any change in its length or points of attachment to the wheel will vary the relation of the record curve to the permanent Zero. All gauge records should be carefully referred to some permanent Zero, or bench mark well cut into the stone, or reference mass, and this Zero or bench mark should be fully and precisely described in the file of tide records, as also all changes in the mark and in the Zero of the gauge itself, as referred to the mark. A common staff guage should always be erected in connection with a self-registering gauge, and as near by as convenient; it being then simply necessary to obtain by careful levelling, the reading of the bench mark on the staff, when it reads Zero at its own reading level, and then to compare the simultaneous indications of the two gauges, for the starting point of the record curve readings. These gauges should have such positions as to receive the full effect of the tide, and when from freezing or other causes the registering gauge ceases to work, the staff gauge must be used for hourly and high and low water observations in the usual manner. The record sheet should always bear upon it the names of the station and observer, the number and scale of the gauge, the dates of beginning and end of the record, the 12 M. dot of each fifth day clearly dated, and full notes of the time and causes of all breaks in the record, and of all new starts, with the interpolated staff guage readings during the record gaps.

After taking these precautions and getting the instrument well started, each Coast Survey Observer is required to visit his station every day until he is sure all is going right, when it is deemed sufficient for him ordinarily to visit it every other day, observing the following directions. "1. The steel rod to which the recording pencil is attached, should always be kept perfectly clean and free from rust; for this purpose it may be rubbed with oiled cloths every week, care being taken that no oil be left on the rod, or allowed in any way to touch the arms which support the pencil resting upon it. 2. If in consequence of a continuation of storms, the tide should fall so low as to render the counterpoise insufficient to keep the chain well stretched, a small additional weight may be added. When the rise and fall is great, or very much influenced by the winds, this may sometimes be necessary; but as there is little strain upon the pencil, the person locating the gauge should in the first place, make the counterpoise sufficient to embrace all but very extraordinary tides. Proper attention to the two foregoing paragraphs will insure an unobstructed motion of the pencil. 3. The clock should be made to keep mean solar time, being corrected to this effect, whenever it is necessary, by a sun-dial or a meridian mark with the equation of time applied, or by such other means as may be found available. 4. Should the clock become disordered, it is not desirable for the observer to disturb its mechanism. Timely notice may always be given to the assistant in charge of the office when any repairs are needed. 5. The clock should never be stopped unless from absolute necessity, or from some unavoidable accident. Whenever it is so stopped, the time and corresponding hour dot upon the paper should be distinctly marked. When it is again set in motion, the first hour dot, together with the corresponding time, should be noted in like manner. 6. The hour dot corresponding to 12 o'clock M., upon the fifth day of every month should be marked. The observer's attention is particularly called to the last two paragraphs. A failure to comply with them will cause much confusion, and must inevitably be detected when the record sheets are sent to the office. 7 The sides of the sheet corresponding to the high and low water should be marked respectively, H. W. & L. W., at the beginning and end of the month. 8. When it is necessary to change the paper at the beginning of the month, this should be done without stopping the clock, and not near the time of high or low water. The time corresponding to the first hour dot after the paper is changed, should of course be marked. 9. The records sent to the office should bear the observer's name and the number of the gauge. This number, together with the scale, is branded on the instrument. 10. In case the clock stops and cannot at once be started, observations with the staff gauge of the time and height of high and low water must be made by the observer, and recorded on the registering sheet, with the date and reason for making the note. 11. When any such difficulty occurs, the observer will in all cases telegraph to the office."

The record sheets are read in the office by the aid of a special table, the sheet being run between two overlapping guides and under a reading scale fixed transversely. A small transparent scale of radiating lines is used for subdividing the half hours, thus giving the means of very close readings about the high and low waters.

In reviewing this description, it will be apparent that this instrument requires care and skill on the part of its attendant, but that with these its records must be of the most perfect kind. Such is the fact, and numerous record sheets already give perfect pictures of a month's tides which are very suggestive of the varying elements concurring in their production. Curve records are much easier to interpret than numerical readings, for the natural continuity is presented to the eye. The record curves are also much more delicate exhibitors of minute quantities than the simple gauge readings. On the whole, the introduction of automatic tidal records cannot fail to promote a critical study of tides, besides saving the drudgery of mere unintelligent watching for the hours.

Self-registering tide gauges have been for some years in successful use at some of the British tide stations, and Mr. Saxton's machine is not original in its general idea. It is, however, exceedingly perfect in its details and nice in its operations, with several important points of originality, especially in the arrangements for using a long record sheet and for marking the time on it. These reasons well entitle it to a pre-eminence greater than we have given it, a pre-eminence which we anticipate it will fully vindicate by its prospective share in the work of elucidating the tides of our two ocean borders.

GOVERNMENT SCHOOLS OF ORNAMENTAL ART IN ENGLAND.

ALL countries whose industrial pursuits have arrived at that point at which they are enabled to supply the necessaries of life, seek in any further development to add the ornamental element to that of utility. To do this successfully, art-education is required, not merely that of the designer or originator of the forms to be wrought out, but also of the workman, by whose skill it is to be fashioned, and by whose intelligence or ignorance it is to be made or marred, in regard to the higher qualities of art.

It is only within the last twenty years that attention has been practically directed to the importance of education as applied to art-manufacture in Great Britain, and institutions founded in which the artisan, as well as the artist, may obtain systematic instruction in the principles and practice of art as applied to his particular pursuit. Nor has this latter point been sufficiently attended to until very recently, and perhaps, even now, there is much more to be done than has been imagined. Under the singular misnomer of schools of design,* the early promoters of the institutions whose title has been lately changed to that of schools of Ornamental Art, proceeded to take the initiative in a system, which properly carried out, was calculated to produce results of the most satisfactory character, and even with all the mistakes, blunders, and perversions to which these schools have been subjected, has done more than could have been expected.

Convinced of the importance of such institutions to the future well-being of the manufacturing interests of England, as well as the advancement of the people in a higher grade of intelligence, a few earnest men, at the head of whom stood Mr. W. Ewart, then M. P. for Liverpool, obtained the appointment of a parliamentary committee on "arts and manufactures." This committee sat, and examined witnesses, amongst whom were men the most eminent in Europe for scientific and artistic attainments, manufacturing skill, and commercial knowledge. They finally reported in 1836, that measures for the promotion of artistic education amongst the manufacturing classes ought to be at once taken, and that the government ought to assist by grants of public money and the organization of a central establishment in London. Accordingly the Government School of Design, Somerset House, was founded for the promotion of the latter object, and as a model establishment. A council of gentlemen, all of whom were eminent either as patrons of art, artists, men of science, or manufacturers, was appointed by the Board of Trade, under which the experiment was to be carried out, and a sum of money having been granted, with the free use of the rooms formerly occupied by the Royal Academy, the new institution commenced its career. Its progress was very slow. The title of the institution perplexed matter-of-fact-people, and it was supposed that none could attend but those who had previously learned drawing; and that its object was to teach those who could draw already, to design. The establishment of a school in Spitalfields, the first branch establishment, did much to make the matter better understood—inasmuch as it took the weaver from his loom, and the youngest boy who assisted him, and proposed to teach them drawing as applied to the silk manufacture, not so much with the expectation of making designers of them, as to make them more intelligent and reliable workmen in the execution of the designs of others. Stimulated by the movement in London, a few leading men at Manchester took up the question, and established a school in that city, not, however, in connection with the government, but as a local experiment. Here the instruction had no reference whatever to industry. It was simply a cheap academy of art in its more general forms of study, and the student was left to apply his knowledge, or blunder in his ignorance as he might, when desiring to apply his art to practical purposes in manufactures. Of course this system failed, and the school at Manchester eventually became one of the government schools subsequently established in the great provincial towns.

The progress of the school at Somerset House, under Mr. Dyce, appointed

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* The founders of the English schools took the French title, "*Ecole de Dessin*," and translating it literally, forgot that in English "design" meant much more than "dessin" in French. By *designing* is really meant *originating*.

director in tho place of Mr. Papworth, who was first selected, caused the Board of Trade to sanction a plan for establishing schools in all the large manufacturing towns and districts in England. Scotland had been provided for many years before by the establishment of the Trustees' School, at Edinburgh. This institution is supported by an income decreed from the investment of certain property confiscated at the rebellion of 1745, and vested by the English government in the hands of trustees for "*the promotion and encouragement of arts and manufactures in Scotland.*" The school is probably the oldest school of design, using the latter term in the popular sense, in Europe; but prior to a change which was made after the movement commenced in England, it had done less for the manufacturing arts, than for tho department of fine arts; nor can this be regretted, since Wilkie, Stanfield, Roberts, Dyce, and many others of the leading artists in Britain, received their professional education within its walls. The last-named gentleman, now W. Dyce, Esq., Royal Academician, was for a period one of the professors, and was selected to visit the schools of art in France and Germany, and report to the government thereon. This report, an admirable document, formed the basis on which it was proposed to erect the English system. Its author was placed at the head of the schools, and his knowledge of his subject, his experience and attainments ought to have secured for his plans a fair trial. Such, however, was not the result. Attempts were made, and in many instances successfully, to hamper the working of an enlightened system of art-education with absurd restrictions, to suit the narrow views of professional artists on the one hand, and the equally mistaken notions of manufacturers on the other. No one seemed to see that to make the artisan, and especially the designer, really useful to himself and others, it would be a waste of time to keep him down simply to the points of practice he had to grapple with, and that to do a thing thoroughly well in art, the power to do much more than the immediate work is necessary. If progress is to be made beyond a given point, this becomes pre-eminently imperative.

A parliamentary grant of about £5,000 per annum having been made, together with a grant of £10,000, to purchase examples of art for the use of the schools, those cities and towns the inhabitants of which desired the establishment of schools, applied to the council in London. If the place was of sufficient importance as a seat of manufactures, and the inhabitants, or the committee or corporation acting for them, guaranteed to raise, by subscription, a sum per annum, equal to the amount of the government grant, which the estimated cost of the school seemed to indicate as desirable, the latter grant was made for three years as an experiment, and in no instance has it been subsequently withdrawn. On the contrary, the grants have been increased in the case of the larger and more important towns to three times the original sum, while in too many instances, the local support has not been equal to the sums raised at the commencement. This provision of pecuniary means, however, did not meet the whole question. In the midst of so many artists, there were very few competent to undertake the management of the schools, who were also willing to submit to the drudgery and toil, and too frequently uncertain results. Art, as applied to manufacture, had to be made popular, not only with the public, but with the artist. Every man who could paint a picture, or model a statue, considered it "*infra dignitatem*" to meddle with the utilities of life, unless "high art," as it was called *par excellence*, could be imported wholesale into decoration and manufacture. Haydon, a clever painter, and a lecturer of singular power, one who did much to promote the present popular taste for the fine arts in Britain, by his able exposition of principles, took a perverted view of this question from the beginning. The early system pursued at Manchester was adopted at his suggestion, and he lived to see it fail most signally, though he still adhered to his doctrine, that *if a student could draw and design the human figure, he could draw and design any thing.* Of this fallacy he was himself an example; for with wonderful power in the former, he failed whenever he attempted any thing approaching to ornamentation in its best forms as applied to the utilities of life. Thus it became evident that teachers must be first educated before the public could be taught, and by Mr. Dyce's advice, a normal class was formed in 1841, in the Central School at Somerset House, and six exhibitions of £30 per annum each were offered to the six best students who were willing to devote their future professional attention to the schools as masters. The masters of the provincial schools first established were selected from this class. It was soon discovered, however, that an unpaid and irresponsible body, like the council of the Metropolitan School, could not work a great and practical question like this with success. Out of twenty-four numbers, very few attended regularly, and the management fell into the hands of some two or three of the most energetic, whose personal predilections and crotchets rather than sound principles ruled the management. With Mr. Dyce's resignation in 1843, commenced a series of changes which ended last year in the consolidation of the whole management into a new department of the Board of Trade, now finally constituted as the Department of Practical Science and Art: Henry Cole, Esq., C. B., and Dr. Lyon Playfair, C. B., F. R. S., being the responsible officers.

The radical defect of the system attempted subsequent to Mr. Dyce's directorship, was an unmeaning centralization of power, and dictatorial tone as to the system, or rather modes of applying the system of education, on which all were pretty well agreed, irrespective of the wants and peculiarities of the various manufactures and local requirements. Mr. Dyce's successor was Mr. C. H. Wilson (now head-master of the Glasgow School), a gentleman possessing many of the requisites for the office, and whose long residence in Italy, and subsequent experience as a teacher in the Trustees' School at Edinburgh, gave him many advantages. Unfortunately, there appeared little fixity of principle in the modes in which the schools were henceforth to be conducted. Changes were made, or attempted to be made in the provincial schools, because they were supposed to be required by the circumstances of the head school, the success of which under repeated alterations was rather problematical. At length this spirit of dictation and unmeaning direction was resisted in one of the most important and successful schools, that of Manchester. The head-master, Mr. George Wallis,* remonstrated against impolitic changes in regard to the school over which he presided, and which had progressed in an unexampled manner during the two years he had managed it. Its success Mr. Wallis felt ought not to be endangered by alterations in the system of instruction, which had no real reference to the wants of the pupils, and which abnegated the necessity for teaching anatomy as the basis of drawing the human figure. The ground now taken was firmly kept, until, by the yielding of the Manchester committee, Mr. Wallis found he could not retain his post with honor to himself or advantage to his students, and he thereupon resigned his position in a somewhat indignant fashion; for he resorted to the very unofficial mode of informing the public of the whole circumstances of the case, defended his own views, stated why he resigned, and worst of all, foretold the results to the institution, and all others which were subjected to the same law of misrule. For three years subsequently, the Manchester School fell in usefulness and popularity, and but for a large increase in the government grant, must have become bankrupt. It was only on a recurrence of the former modes of management and principles of instruction, together with the appointment of the present head-master Mr. Hamersley, whose success at Nottingham pointed him out for promotion, and as the most likely man to redeem the important school of the cotton metropolis, that the classes rallied in numbers, and became once more successful, and this too in the face of a debt accumulated during the emasculating process, which changed a large balance at the bank into a considerable liability on the other side.

Nor was it long before the system, against which such "heavy blows and great discouragements" had been hurled from Manchester, began to shake at head quarters. Mr. Herbert, R. A., a most eminent artist and successful teacher of the figure, resigned his appointment, and indignantly repudiated the management. In the end, after some eighteen months of uncertainty and inquiry, the Council at Somerset House was abolished, and a Commissioner of the Board of Trade was appointed to superintend the general management of the schools, while three eminent artists were appointed to tho entire direction of the educational department These were Mr. Herbert, R. A., Mr. Redgrave, R. A., and Mr. J. H. Townsend. Mr. Wilson, the late Director, took the superintendence and inspection of the Provincial Schools; but this arrangement existed only for a short period, and he was subsequently appointed Head Master at Glasgow, a post in which his talents were well fitted to secure him success.

It is now time to say something about the Female department of these schools. This had been first commenced in 1842 under the direction of Mrs. McIan, a lady whose pictures are an honor to her country, and whose devotion to her duties, and the success which has followed that devotion, notwithstanding the many difficulties in which she has been placed from time to time by the apathy, and often opposition of the management, deserve the highest consideration. This Female school was intended to give instruction to females desirous to devote their time to the pursuit of those industrial departments of art, for which their sex might fit them without degradation. Drawing and engraving on wood, lithography, china painting, designing for lace, printed goods, silk, silver work, even to the modelling of the latter, were suitable branches of industry. Mrs. McIan visited Sevres and the Staffordshire Potteries, made herself practically conversant with the various methods of painting china, and this, too, as only one part of her duties. In fact, an intelligent and earnest mind was at work on a suitable subject, and success was the result, even under all the difficulties to which we have alluded. Of the present state of the Female School, we shall have occasion to speak hereafter.

The result of the utter want of systematic management in London re-acted upon the Branch Schools, and the extreme of a stereotyped course of study, without regard to the varied requirements of each manufacturing locality, resulted in another extreme, in which each master did what was right in his own eyes, and most profitable or convenient for his own purposes. The abolition of the nor-

* It may not be uninteresting to state, that Mr. Wallis, who has recently visited the United States, as one of the Royal Commissioners from Great Britain, had advocated the cause of art-education for the artisan, long before his connection with the schools. His experience as head-master at Spitalfields, and his success there and at Manchester, gave his opinions great weight, though this was not felt at the time. They were made of more and more value by his untiring attention to the practical questions of art-manufacture, and his efforts as a writer and lecturer, from the period at which he threw up his post at Manchester, until his unsolicited reappointment as head-master at Birmingham in 1851, after five years absence from official duty.

mal class for training and qualifying masters, rendered it necessary to select students from the Royal Academy—clever painters of small pictures, or incipient sculptors, who, valuing the appointments from the convenience they afforded of living whilst executing unsalable, works, cared little for the schools, and still less for their real purpose, that of applying art to manufacture. Upon the latter, they either looked with contempt, or were content to remain in ignorance of the very thing they had undertaken to teach. As might be expected, the Schools of Design, originally intended as schools of ornamental and industrial art, became neither more nor less than drawing-schools, chiefly for the children of the middle classes. Nor was drawing taught upon a scientific basis. The examples of the ordinary drawing-master were used, and conventional landscape took the place of severe outline, prettinesses usurped the place of true art, and the artisan, neglected and disheartened, found little to attract him to devote his leisure hours in learning that which was useless to him when mastered. In one school young ladies of good family and ample means were getting instruction in drawing as an accomplishment at *three cents* per lesson, the rest being paid out of the public funds, whilst the wants of the class of workmen and their sons, for whose especial instruction this school was founded, were all but neglected. Such a state of things could not go on for any length of time, and accordingly, in 1849, Mr. Milner Gibson, the member of Parliament for Manchester, obtained the appointment of a Committee of the House of Commons to inquire into the whole system of management. The result of this inquiry was the full proof that the schools had not done their work, that they never would do it without a more distinct system of direction and supervision, and that the wants of each district in its own special manufactures, should be consulted in the direct application of the system of instruction pursued, whatever that might be. The Government, for the time being, resisted any change emanating from the report of the Committee; but, that report once disposed of, a desire was shown on the part of the Board of Trade, to render the schools more efficient in the plans indicated by the evidence given before that Committee. The Great Exhibition of 1851 intervened, and those who had agitated the question were engaged in carrying out that undertaking to its conclusion. Early in 1852, however, a new department of the Board of Trade was organized, to be called the Department of Practical Art, at the head of which Mr. Henry Cole, C. B., one of the most active members of the Executive Committee of the Great Exhibition, was placed as General Superintendent, with Mr. R. Redgrave, R. A., as Assistant Superintendent. To their care and management, as heads of the department, the whole management of the schools was to be confided. Here there was a real tangible beginning of a system of responsibility, which had been so long advocated.

As a beginning of the new organization, the Queen granted the use of that part of Marlborough House, formerly the residence of Queen Adelaide, and the future residence of the Prince of Wales, which was not occupied by the pictures of the Vernon Collection. These unoccupied rooms presented many conveniences for the purpose, and were at once fitted up and adapted for class and other rooms. A lecture theatre was formed out of the kitchen of the palace, royal bedrooms became suddenly useful as libraries and offices, but above all, a portion of the building was devoted to the formation of a museum of manufactures, in which art as applied thereto, could be illustrated in its best forms, and the choicest examples placed before the manufacturer, the artisan, the student, and the public; thus teaching all, by the best of processes, an appeal to the sense of propriety and fitness, whilst contemplating the beautiful. Fortunately for this movement, the Great Exhibition had brought together the choicest productions of modern times. By the advice of Lord Granville, who, as Vice-President of the Board of Trade, was the ministerial head of the schools, the government had determined to apply £5,000 sterling in the purchase of examples for the use of the schools about to be so thoroughly reformed. Four gentlemen were appointed as a committee to select them, Mr. H. Cole, Mr. Pugin, Mr. Owen Jones, and Mr. Redgrave, R. A. The whole of the grant was not expended, but a fine selection of articles was, on the whole, made by them. These, together with a very fine collection of works of a similar character, purchased at the Paris Exposition of 1844, but which had been scarcely ever seen by the public, having been placed in out-of-the-way corners in the school at Somerset House, formed the nucleus of this new and practical museum of modern skill and industry. In addition to the articles thus purchased for the nation, the Queen has lent many excellent specimens of ancient and modern art in gold, silver, china, and in decorated armour and furniture, the nobility and collectors generally following so excellent an example. This museum is *free* to the public on Mondays and Thursdays, but on Wednesdays, Thursdays and Fridays, it is open to students of the Department only, and those of the public who go for study, and the value the latter set upon this privilege is tested by a fee of sixpence. This museum, though not yet very extensive, has become a point of attraction to all intelligent visitors to the Metropolis.

The formation of special classes for instruction in Art, as directly applied to manufactures, having been determined upon, the higher departments of art hitherto taught at Somerset House, were removed to Marlborough House. A change was thus made in the character of the former, which became simply a preparatory school for the latter. More recently it has been or is to be abolished altogether, as the public service requires the departments for offices, and the functions of this single school are to be performed by a number of elementary schools spread over the London districts at convenient distances from each other.

In connection with so rational a mode of meeting the wants of a large city, by a number of small establishments rather than a solitary great one, elementary schools are proposed and are now in course of establishment in many provincial towns, whose claims to a grant for a school of Ornamental Art would be more than problematic, while the means of supporting one by local means would be totally inadequate. These schools, commencing with the elements of drawing, prepare the student to take advantage of the higher and more advanced classes in the larger schools. In connection with this movement also, there is a plan for extending instruction in drawing into any primary school which receives State support. This is of a very elementary character, but the teachers, male and female, are expected to qualify themselves to give such instruction, and classes for teachers are found in nearly all the large schools of Ornamental Art, in which instruction is given *free*. Eventually there can be little doubt that the power to draw, and teach its elementary practice and principles, will be an indispensable requisite in any teacher applying for a certificate.

Of course a most important point in the successful management of these schools, is a proper provision for a constant supply of good examples at a cheap rate, and also the supply of good and cheap materials. The old management made grants of examples to the various schools, free of cost; such examples, however, were still considered to be the property of this government, in the event of the school in which they were deposited being abandoned, or being prevented from its legitimate use. The examples usually consisted of an admirable series of ornamental casts, from the best antique specimens deposited in the various museums of Italy, France, Germany and England, and also of full size plaster casts of the more celebrated antique statues, such as the Apollo Belvidere, Venus de Medici, Discobolus, the Fighting Gladiator, or Agas, as it is sometimes called, the Theseus and Ilissus of the Elgin Marbles, and others. Examples in color were also furnished, but owing to their cost but very sparingly. In the elementary departments of the schools an abundant supply of excellent lithographs were furnished as examples for crayon practice, and an admirable series of outlines, prepared expressly for the use of these schools, by Mr. Dyce, during his directorship. Nor should the works by Grunez be forgotten, since they also contain some admirable examples in the midst of much which might have been better done. This work was published under the sanction of the Council of the School of Design at Somerset House, an undertaking being given that a certain number of copies should be purchased for the use of the schools, as some guarantee to the publisher against loss. In the matter of materials, nothing was done until the present department was organized, and in this important point samples of materials, with the prices and the address of those who make or sell them, are now given at the cost price of the samples only.*

Examples are no longer supplied, or perhaps it would be more correct to say lent, free. It was found that in too many instances the examples supplied were not useful to the locality to which they were sent, or their use was neglected. The plan now adopted, is to supply whatever examples any school may require for absolute use, at *half the cost price*, the other half being defrayed out of an annual grant of money made for that purpose. The fact of paying half price, proves that the examples are wanted, and therefore that the remaining half may be safely calculated upon as well spent from the public purse.

In addition to the examples requisite for study, grants of valuable works on art were made to the largest of the provincial schools, thus forming a library of reference in each district, whilst the wants of the students, as regards the history of art and all matters connected therewith, were provided for by well selected lending libraries, from which students of proper age and standing were privileged to borrow works bearing upon their pursuits in art. From the floating character of the population, it was found, especially in London, that the lending library required renewal very frequently; and it is now abandoned at Marlborough House, the new centre of the schools. In most of the provincial schools, however, lending libraries still form one of the many advantages offered to students, but the dilapidation of the books, frequent losses, and no source of further supply, must ere long tend to the same result as at head-quarters. The libraries of reference are kept up with great care, and most of them afford excellent means of correcting the taste of designs and manufactures, as in most instances they are freely open at proper hours to all who wish to examine or consult them. At Birmingham, for instance, the school prospectus concludes with an invitation to all persons interested, to avail themselves of the library under certain orderly regulations. At Marlborough House, London, the library has been thoroughly classified, and where defective, renewed. Additional works are constantly being bought, and any student of art, manufacturer, or designer, can have any work upon any style of art, if in the library, handed to him to consult, or to make sketches and memoranda from it.

* A collection of these examples and diagrams is now exhibited in the Crystal Palace by the Department of Practical Art.

With regard to the kind of instruction given, it would occnpy too much space to go into all the details. Without attempting a minute accouut, it will therefore be sufficieut to say, that it comprises a course of geometry and perspective, simultaneously with a rigid course of free-hand outline drawing from a selection of ornaments of pure styles, and of the hnman figure. When this course is gone through in a satisfactory manner, the stndent is taught shading in crayon or chalk, first from the flat, to give him a true method of handling, and then from the cast; and his subjects may be either antique ornament, or the human figure. A course of anatomy, illustrative of the latter, is also pursued. In the study of color, the practice is first in monochrome from the cast, and then from the smaller objects of nature, such as flowers, prints, shells, etc., which are usually grouped as compositions of color. In modelling, which is practically taught in most of the schools, the students are carried from the first efforts in clay from the cast, to modelling from nature, and to the realization of designs for manufacturers. The technical instruction, given in these schools, beyond that which applies to artistic practice, is very limited, and how far it shall or shall not, can or cannot be carried, has been a principal source of dispute, amongst those who have the greatest interest in the schools and their projects. One thing appears quite certain, that to make them into centres for supplying the actual designs for manufactures, supposing this could be done, would be to bring them down to the level of the manufacturers' taste, while the one great purpose for which they were originally established was to elevate that taste, as also that of the artisan and general pnblic. In short, the functions of these schools is to make designers, not designs, but in doing the former there must of necessity be more or less of the latter done or aimed at. After all, however, the real technical knowledge can only be attained in the workshops or in the factory; and the most practical, as well as the most practicable view, is to seek to give the artisan such an amonnt of artistic knowledge as shall enable him to become an art workman, apt at realizing the designs and inventions of others with accuracy and taste, while, should he possess originality himself, his artistic practice and technical skill will go hand in hand, and render him more fitted for his position as a leader. The first thing, however, is to make a good and orderly follower of him, alike in art and in manufactures.

The Schools of Ornamental Art at present in operation in Great Britain and Ireland, are located at Belfast, Birmingham, Cork, Coventry, Dublin, Glasgow, Leeds, Limerick, Macclesfield, Manchester, Newcastle-upon-Tyne, Norwich, Nottingham, Paisley, Staffordshire Potteries (Stoke), Sheffield, Spitalfields, Stourbridge, Worcester and York. To this, it should be understood, are now added a considerable number of elementary schools as the commencement of others of a more extended character, whenever the wants of the respective localities in which they are situated become apparent in the uses made of the instruction provided. The latter, however, have no absolute grant of money. The department provides a properly trained master, and guarantees his stipend for the first year, if the fees of the students do not amount to the sum required. The necessary accommodation as regards class-rooms, furniture, gas-fittings, care-taking, and half the cost of examples, must be absolutely undertaken by the locality; and there can be little doubt that this is the correct policy now to pursue in relation to these institutions. Still, had such a system been adopted at the outset, it is more than questionable whether many of the Schools of Art now in operation would have had an existence, and there can be little doubt that many of them would have been abandoned by their provincial promoters, had so serious a binder been thrown upon them as the responsibility of rendering them self-supporting; for, strange to say, the majority of the manufacturers of England are exceedingly apathetic upon the snbject, and while they complain that the instruction given is not as practical as it ought to be, they neither use their influence, nor their money to assist in making it so. Hence many of the schools, until the recent changes in the central management, had fallen into mere dilettanti drawing-classes, from the fact that those who directed them had little or no perception of their true uses; and the public found it pleasant to get instruction in making pretty drawings at a few cents per quarter, instead of paying an equitable number of dollars. But while this system has, so far at least, been put an end to, there is yet the difficulty to overcome of showing the great manufacturing houses that self-snpporting Schools of Art which will do their work in the right spirit, are practicable; for the popular drawing-class element may be carried to such an extent as to completely absorb the more essential quality of providing for the wants of the artisan. Here lies the difficulty. Art, as applicable to manufacture, is one thing; whilst art, as a mere accomplishment, is another. Hundreds will be found to pay the requisite fees, and go through such a course of study as may answer very well for manufacturing pretty pictures; but for the purposes of the loom, the casting shop, the potter's wheel, the printing machine, and the glass furnace, another, and by no means popular course, is necessary. Severe forms can only arise out of the application of severe principles, and in working out severe courses of study, and to this none but the professional student will submit; because it is thought that the mere amateur can succeed without the knowledge required by the artist or the art-workman. Thus we conclude, that to have the requisite work done, the government must pay for it, since the popular drawing-class is the only thing the public care to pay for, in the shape of fees. But we also hold, that whilst the government is called upon to pay for the suitable instruction, it ought also to see that such instruction is given. This was a matter of minor importance with nearly all the previons managements, but it is to be hoped sufficiently understood by the present one to insure success, provided the self-supporting principle, based on the popularity-seeking system, is not carried so far as to make the wants of the manufactnrer secondary as compared with the self-support of the schools.

On analyzing a table, published in the first official report of the new department, we find that the grants to the various provincial schools before enumerated amount to £7,500, and that the fees received from students are £2,788 4s. 4d. The local subscriptions, donations, &c., amount to £5,146 18s., thus giving a total income of £15,347 12s. 9d. for the year ending 31st December, 1852. The expenditure shows a total of £13,118 2s. 3d. For this expenditure, 3,762 males, and 1,106 females are receiving artistic education, or at least are so reported. The kind and degree of this instruction is, as we have shown, open to grave exception by the earnest advocate of a thoroughgoing system as applicable to really useful purposes.

In the returns from nearly all the schools, the occupations of the students are given; but when we see the great city of Manchester neglecting to give this most important item of information, and retnrning round numbers of portentous amount as the number of students *on the books* (a most equivocal mode of return), we naturally seek to see what further impression is given from this important locality. On turning to another table, in which returns are made from the date of the establishment of each school to 1851, the same school returns, strangely enough, less than half the number as the average; thus the difficulty of giving the occupation of the 700 is shown by the fact that 322 is nearer the mark, whilst the amount of fees received in the year 1852, always a good test, since the money must be accounted for, is only £262,16s., which clearly gives even less than 300 students. Now this example of an official return is quoted to show, how little dependence a government can place upon the expenditure of grants for the results of the application of which it does not clearly hold the administrators responsible, by seeing that the work undertaken to be done is actually accomplished; a point about which, until recently, officials at head-quarters scarcely troubled themselves. It is only right to say, however, that the returns from all the other schools appear to be fairly given, the lists of the occupations of the students being curiously illustrative of the trades of the various localities. The ages, too, are given in groups, and show that the greatest number of those who attend are between fifteen and twenty, a large number being also between twenty and thirty, and many above thirty years of age. The average period of attendance, however, would appear not to be above two years and a half, and this too, irrespective of the many who do not attend a whole year.

In London a great change is now in the course of being effected. Instead of a single school at Somerset House, several elementary schools are established, whilst the rooms, previously occupied in that great centre of government offices, have been given up to the registrar-general, and its business transferred to Marlborough House, where all the advanced classes are conducted. The female school being located in the neighborhood of College University, goes on much as it has done, as regards its elementary course of instruction, but is now being made more extensively useful than formerly.

There is one point in connection with the support of these schools, which appears to have been a fruitful source of discussion wherever the pecuniary question has been raised. In the provinces large subscriptions are required to assist in their support, in the metropolis this is not done. Even Spitalfields, a branch school, received the whole of its support from the government, except some £40 or £50 per annum, until lately. The provincials maintain, that while London possesses innumerable advantages for the study of art, in nearly all its forms, provincial towns have rarely any except such as may be afforded by the establishment of a school of ornamental art; and yet a provincial town is called upon to bear half the cost of an institution so much needed, but the metropolis gets the government grant without any conditions. The reply is, that a central institution is essential for the proper training of masters for the provincial schools, and that a great portion of the expenses of the metropolitan schools, ought to be set down to the provincial ones. The line of contention, however, still exists, and promises to form no unimportant point in the final question as to how far the provincial schools are to be self-supporting.

Under any circumstances, it is the policy of a wise government to encourage such institutions as these, the working of which in Great Britain we have been endeavoring to illustrate. Their influence, imperfectly as they have been as yet worked, has been very important. Under a more earnest and stringent system of supervision, with the experience of the past to rely upon, their future career cannot fail to be marked with beneficial results alike to the artisan, the manufacturer, and the general public. For, in an age like the present, in which the ingenuity of man is so strikingly manifested in the rapid development of means of manufacture, by which the useful can be made ornamental, in some instances at even less cost than it can be constructed without decoration, it is not too much to say, that that country which pays most attention to a matter becoming daily of more im-

portance, must take the lead alike in commerce as it does in the arts, and apart from the ripening influence of the latter, must realize advantages of no mean importance to its future progress in civilisation.

We have devoted so considerable a space of the Record to the history of the foundation and vicissitudes of the schools of Ornamental Art in England, and to an explanation of the course of study pursued in them, not only because we thought the subject a highly important one, but in the hope that our article might attract attention here, and induce wealthy, influential, and liberal citizens to provide similar schools for the instruction of our own artisans.

ELECTRIC TELEGRAPHS.

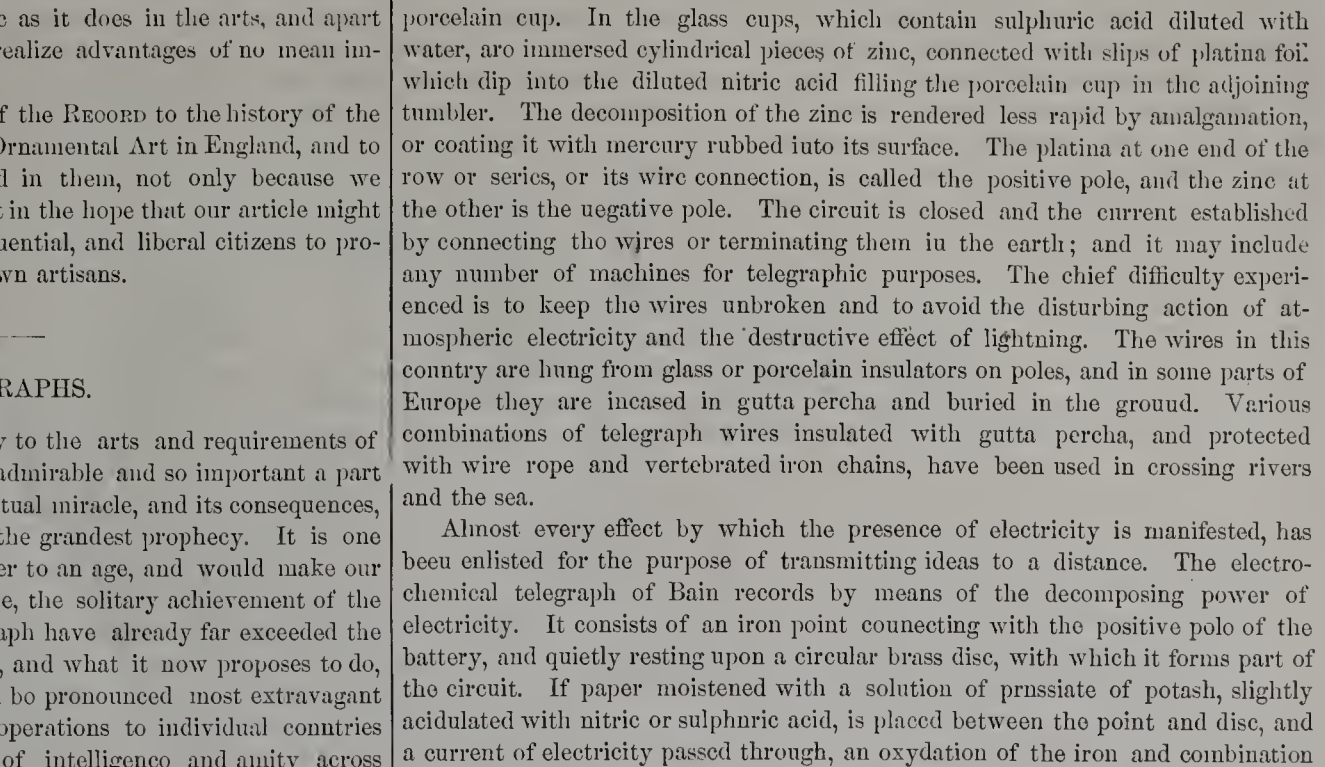
AMONG the many applications of electricity to the arts and requirements of civilised life, there is none which plays so admirable and so important a part as the Electric Telegraph. Its power is a perpetual miracle, and its consequences, political and social, might be the theme of the grandest prophecy. It is one of those immortal discoveries that give character to an age, and would make our own for ever memorable, though it stood alone, the solitary achievement of the time. The capabilities of the Electric Telegraph have already far exceeded the hopes of the most sanguine of its early friends, and what it now proposes to do, without a knowledge of its past history, would be pronounced most extravagant and chimerical. It no longer confines its operations to individual countries and continents, but is stretching its bonds of intelligence and amity across the wastes of oceans, and preparing to make every man a Prospero, with a far swifter and more accomplished Ariel to serve him. Our Atlantic steamers bring us intelligence from all parts of Europe up to the moment of their departure, by means of the electric link, which, lying deep in the arm of the ocean between England and France, silently conveys the news of revolutions upon which hang the fate of nations. A company has been formed to connect Cuba with Florida, and another has fairly entered upon the work of spanning the Atlantic. Now that it is the most prominent scientific application of the age, old inventions and ideas, which, at the time of their conception, had only vitality enough to find a place in the record of history, and had since slumbered for years, have again come to life, and deriving strength and importance from their antagonists, have urged a competition for honor with those inventions which first converted an abstract idea into a practical fact, and brought it forward for the benefit of the world. In the first experiments of Francis Ronalds, of England, who proposed and built, in 1823, a telegraph extending over a distance of 175 yards, operated by frictional electricity, the wires were enclosed in thick glass tubes carefully joined with wax, and placed underground in wooden troughs lined and covered with pitch; and it is now a well established historical fact [*Phil. Trans.*, vol. XIV., 1848], that more than one hundred years ago Dr. Watson extended his experiments over a space of two miles near London, and used a single wire, the ground forming the return and completing the circuit. And in the year 1748, Dr. Franklin set fire to spirits by means of an electric current sent across the Schuylkill on a wire, and returning in its circuit by the river and the earth. In 1837 it was again discovered by Steinheil that the conducting power of the earth could be advantageously substituted for one of the wires, and that it was unnecessary to connect each pole of the battery with the telegraph apparatus at the distant station. The saving of the cost and repairs of one out of every two wires is not the only advantage derived from this discovery. The conducting power of the earth is so superior, that it adds nothing to the resistance, and acts too as the return connection to any number of distinct wires and batteries, without affecting the independent action of any of them. It is believed that in the year 1825 Mr. Sturgeon, of England, constructed the first *electro-magnet*, by coiling a copper wire around a piece of iron of a horse-shoe form, the turns being kept apart to prevent the transmission of the electricity between them. He found that when the electricity was passing through the coil, the inert mass of iron enclosed was endowed with all the wonderful properties of a magnet, and lost them again on the instant the current was interrupted.

But it is not our intention to write a history of the ideas and discoveries which reached their consummation in the Electric Telegraph. We have only to explain the methods mostly in use upon the fifteen thousand miles of telegraphic lines now in operation in the United States, and which are illustrated by the working machines exhibited in the Crystal Palace.

Grove's batteries are most generally used in this country, and consist of a series of glass cups or ordinary tumblers, in each of which is placed an unglazed porcelain cup. In the glass cups, which contain sulphuric acid diluted with water, are immersed cylindrical pieces of zinc, connected with slips of platina foil which dip into the diluted nitric acid filling the porcelain cup in the adjoining tumbler. The decomposition of the zinc is rendered less rapid by amalgamation, or coating it with mercury rubbed into its surface. The platina at one end of the row or series, or its wire connection, is called the positive pole, and the zinc at the other is the negative pole. The circuit is closed and the current established by connecting the wires or terminating them in the earth; and it may include any number of machines for telegraphic purposes. The chief difficulty experienced is to keep the wires unbroken and to avoid the disturbing action of atmospheric electricity and the destructive effect of lightning. The wires in this country are hung from glass or porcelain insulators on poles, and in some parts of Europe they are incased in gutta percha and buried in the ground. Various combinations of telegraph wires insulated with gutta percha, and protected with wire rope and vertebrated iron chains, have been used in crossing rivers and the sea.

Almost every effect by which the presence of electricity is manifested, has been enlisted for the purpose of transmitting ideas to a distance. The electro-chemical telegraph of Bain records by means of the decomposing power of electricity. It consists of an iron point connecting with the positive pole of the battery, and quietly resting upon a circular brass disc, with which it forms part of the circuit. If paper moistened with a solution of prussiate of potash, slightly acidulated with nitric or sulphuric acid, is placed between the point and disc, and a current of electricity passed through, an oxydation of the iron and combination with the prussiate is induced, forming prussian blue and depositing a dark blue mark. The disc is revolved by clock-work, and the iron point is guided by an arm resting in a groove in the central portion of the plate, and traces dots and marks or blanks in a spiral direction on the paper as the current is closed or broken. The discoloration is effected instantaneously, and it has the additional advantage of being performed with a much more feeble current of electricity than would be required to produce a mechanical result. There have been several modifications proposed for the purpose of transmitting fac-simile copies. The principle involved is to break and close the current by writing with dissolved sealing wax or other non-conducting material on the surface of a cylinder included in the circuit. The cylinder revolves slowly by means of clock-work, and as the fine point of the style passes over the writing, the current is broken, and there is a blank left on the prepared paper wrapped upon a similarly conditioned cylinder at the other terminus, which the electricity would otherwise cover with a finely traced helix. The axes of the cylinders are cut with screw threads, so that a revolution shifts them endways a slight distance, corresponding to the fineness of the screw. When this machine becomes a quick-working and reliable instrument, it will be an important acquisition in business operations, and might be found useful in transmitting an outline picture or likeness of a fugitive rogue.

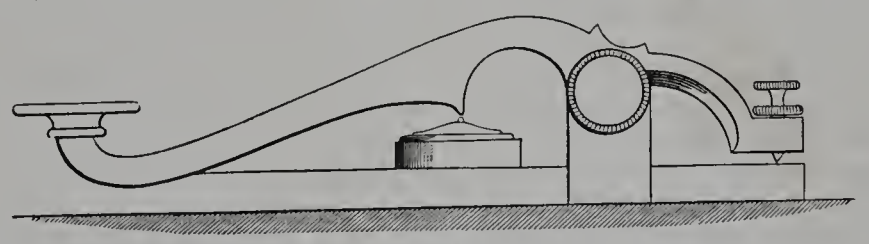
The first application for a patent for an electric telegraph, by Samuel F. B. Morse, was made in 1837; and the first line in the United States was built by him, in 1844, between Washington and Baltimore, in which enterprise he was assisted with thirty



MORSE'S ELECTRO-MAGNETIC TELEGRAPH.

thousand dollars, appropriated for the purpose by Congress. In the recording instrument represented above, there is a piece of pure, soft iron, of the ordinary horse-shoe magnet form, wrapped with many hundred convolutions of fine copper wire carefully insulated by a covering of silk. When the circuit is closed, and the current of electricity flows through the wire, the iron becomes magnetized, and attracts the armatures attached to one of the arms of an axis, which carries on its opposite side an arm furnished with a steel point, regulated by a screw, and pressing through the interposed paper into a groove cut on one of the rollers

of a pair which are moved by a system of wheel-work, and carry the paper from its spool regularly forward. If the circuit is kept closed any appreciable time, the paper is marked with a line corresponding to its motion. So soon as the current is interrupted, the iron becomes demagnetized, and the spring attached to the vertical arm extending downwards from the axis, throws the armature up and disengages the point from the paper, which continues to move forward without further impression. If a mere momentary impulse is given to the current, the point impresses only a dot upon the paper. The current is broken and closed by the finger key shown in the annexed figure. The operator presses upon the button, and the point on the key is brought in contact with the corresponding point on the base piece, and, as they both form parts of the circuit, the current is established, and a dot or line traced on the paper of the recording machine according to the time of contact. On removing the finger, the spring attached to the key throws it up, and breaks the circuit. The various combinations of dots, lines, and spaces

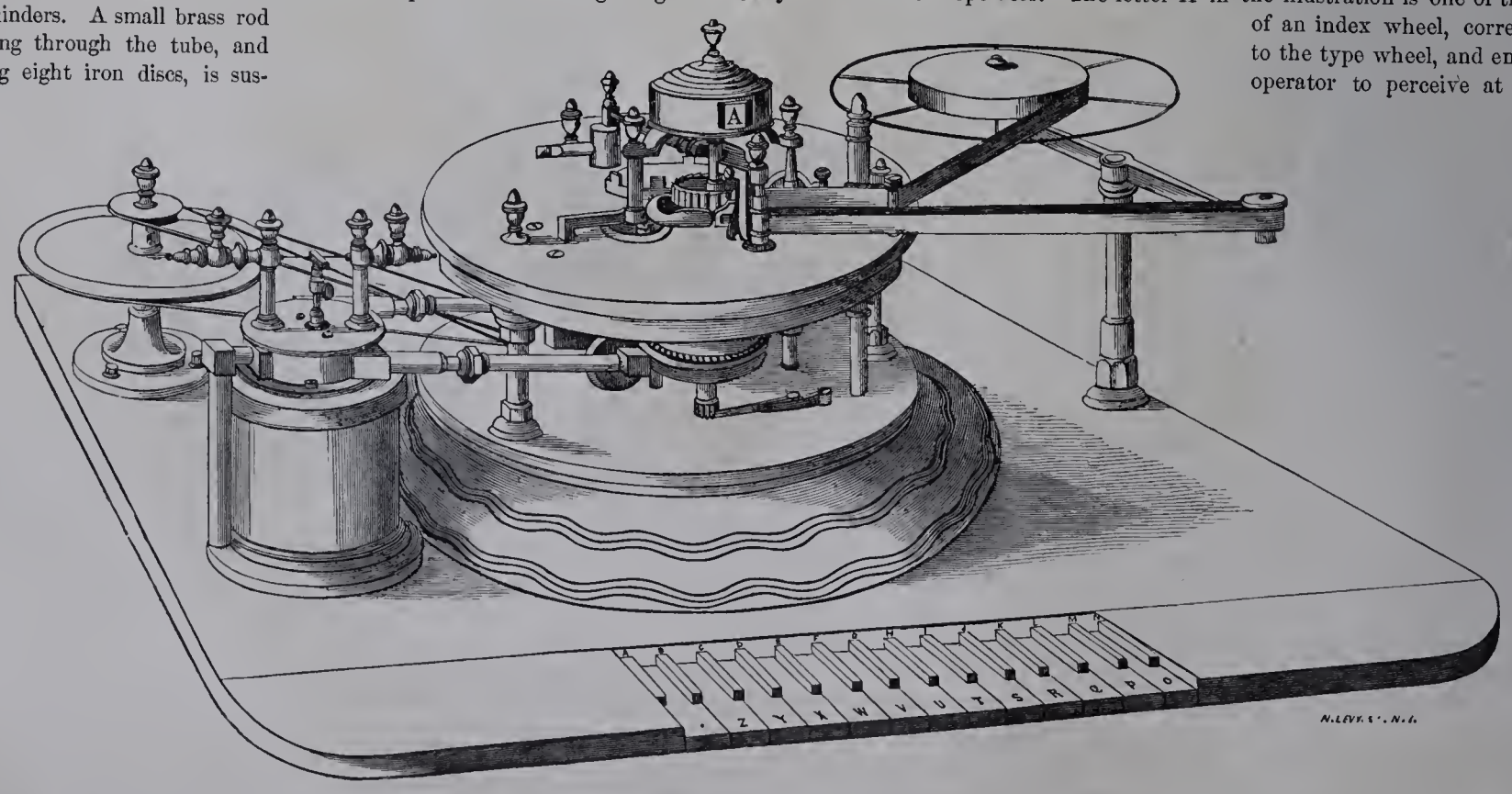


FINGER KEY.

are arranged to represent letters or words. At first, Professor Morse proposed to use what he styled a port-rule, consisting of types of dots and marks set as they were to be recorded, and traversing an instrument similar to the finger-key, and giving to it a corresponding motion. This mechanical contrivance was soon superseded by the finger-key, with which the dexterous manipulation of a practised operator determines the lengths of the marks and spaces with sufficient accuracy for practical purposes, and, although a single letter sometimes requires three or four motions of the finger, transmits them at the rate of one hundred a minute. It is found that in passing through a long wire the electricity becomes dissipated, and reaches the distant terminus in too enfeebled a current to perform the mechanical execution required. To obviate this, relay magnets are used, similar in principle to the recording instrument, but dispensing with the wheel-work, and using the point to break and close the current of an additional set of batteries, which is thus brought into operation, and sends its power as far as may be practicable to employ another battery; which, in its turn, may perform a similar duty, or merely work the recording machine at the terminus.

The imperfect drawing of the beautiful and ingenious machine invented by Royal E. House, serves the purpose of a cursory glance at the instrument itself, by suggesting the idea of an exceedingly complex arrangement of parts, which require a careful examination to be understood. The cylinder shown on the left contains a helical coil of fine copper wire, well wrapped and insulated with silk, and forming the circuit with the telegraph wire. A brass tube, of about half an inch in diameter, is placed in the coil and has disposed inside its length eight short iron cylinders. A small brass rod extending through the tube, and carrying eight iron discs, is suspended from the horizontal wire seen stretched by set screws between the standards above the cylinder.

The electricity traversing the coil magnetises the little iron cylinders and discs, and causes them to attract one another and draw the rod downward. On the cessation of the current, the rod is drawn up by the spring of the horizontal wire; and thus the closing and breaking of the circuit occasions a vibration of the brass rod and a small piston valve carried by it in the air-chamber in the upper part of the cylinder. This chamber is supplied with air from a pump attached to the frame of the machine, through the vertical pipe; and the office of the valve is to alternately supply the two horizontal pipes connecting with the opposite ends of a cylinder situated under the upper plate of the instrument and containing a piston governing the motions of an escapement, in a manner similar to that by which the escapement of a clock is governed by its pendulum. The motion of a type wheel, with the twenty-six letters of the alphabet and a period and blank engraved upon its twenty-eight projections, is regulated by this escapement. The air governs the motion of the type wheel, and is in its turn regulated by the electricity. The machines are built in pairs, comprising the above partially described recording instrument, and the composing instrument; each connected when in operation with its fellow at the other terminus. The composing machine consists of a cylinder situated under the lettered keys and carrying at one end a brass wheel called the circuit wheel, with one end of the telegraph wire in contact with its side. Its periphery is cut with fourteen slots, and has pressing against it an end of the telegraph wire fashioned into a spring, so that as the cylinder and wheel are revolved the circuit is broken or closed by the passage of the spring over a slot or projection. A detent on the lower side of each key catches a pin in the cylinder and arrests its motion, and also that of the type-wheel in the recording instrument. Now suppose the letter A to be opposite the slip of paper placed to receive the message to be transmitted, and the key marked A detaining the cylinder and its wheel, with the circuit closed by the conducting spring resting upon one of the projections. On putting the machine in motion and releasing the key, the current is broken by the spring passing over the slot in the circuit wheel corresponding to B, and the escapement adverted to in the recording instrument, allows the type wheel to revolve the space of one detent and present the letter B. The spring again closes the circuit with the next projection on the circuit wheel, and the type wheel presents the next letter; and these operations are repeated in rapid succession until the motion of the cylinder is arrested by pressing down one of the keys, and causing the type wheel to stop with its corresponding letter opposite the paper. When the type wheel of the recording machine is put in motion, a second peculiar escapement is detached and held in abeyance until a cessation of the motion allows it to act, and, by means of an eccentric connected with it, draw the paper against the type wheel and produce the required impression. The motion of this escapement also releases the paper from the type after impressing it, and causes it to unroll from its spool and advance a slight distance to present a blank for the next letter. A blackened strip of paper is also drawn against the type and causes the letter to be fairly printed, at the rate, in ordinary communications, of two hundred a minute. The motions of the type wheel and its two escapements, and of the air pump and the circuit wheel, are all communicated through pulleys and bands from a treadle, worked by the foot of the operator. The letter A in the illustration is one of the letters of an index wheel, corresponding to the type wheel, and enables the operator to perceive at a glance the condition of the instrument, and allows the letters to be read as they are presented, if it should be desirable to remove the type wheel or paper and prevent the recording operation taking place.



HOUSE'S ELECTRIC PRINTING TELEGRAPH.

The magnificent Service of Gold Plate, which we engrave upon this page, deserves the particular regard of every American. It commemorates an event of national importance, one that added distinguished honor to our country, and materially enhanced our reputation for enterprise and power.

It bears the following inscription:—

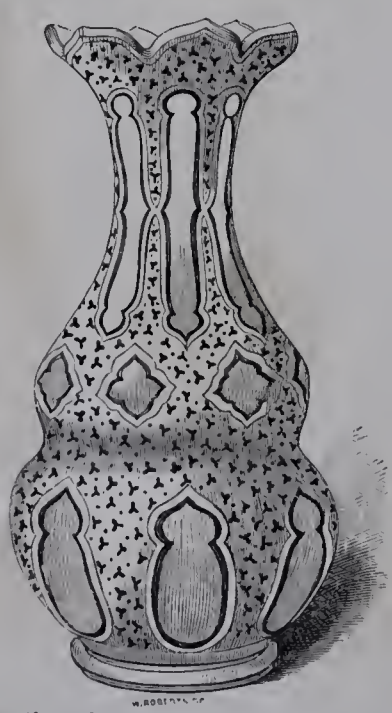
"This Service of Plate
is presented by the citizens of new-york
to
Edward K. Collins,
"In testimony of the public sense of the great honor and advantage which has been conferred upon this city and the whole country, through his energy and perseverance in the successful establishment of an American Line of Transatlantic Steamers.
"August, 1851."

The Collins' Plate was manufactured by the eminent goldsmiths of New-York, Messrs. Ball, Black & Co., by whom it was exhibited in London, and is now displayed in the Crystal Palace of New-York. It is entirely composed of California gold, and is valued at $5000. Its workmanship is highly creditable to the skill and taste of the manufacturers.

Among the means and appliances of civilised life which the ingenuity of man has appropriated from nature, or has himself invented, there is scarcely one which holds a more important place than glass. It would be difficult to find another material that could supply its place with advantage in domestic economy, and the various ornamental articles of elegant luxury, while in the most important branches of scientific research, it is of indispensable use. It were needless and foreign to our present object, to enlarge upon its perfect applicability to the purposes for which it is designed, or attempt to do more than refer to the thousand forms of use and

beauty which it assumes at the will of the artist and artisan. We have engraved on this page numerous specimens exhibited by J. Maes, Gallerie de Clichy, Paris, which illustrate some of the useful applications of glass, united with ornament of unexceptionable grace and propriety. They are made of that variety of glass called Bohemian, a double silicate of potash and lime with a minute quantity of alumina. The Vase and Toilet Service at the top of the page, are of the much

admired ruby glass, colored with suboxyd of copper, or with gold. Most of the specimens are "cased," a term applied to articles which are made of several successive layers of glass, each of a different color. The casings are united into a homogeneous mass in the following manner. The workman collects upon the punty rod a ball of glass of whatever sort he chooses to form the body (usually colorless), and while the ball is still red hot, he applies a cake of colored glass which melts more

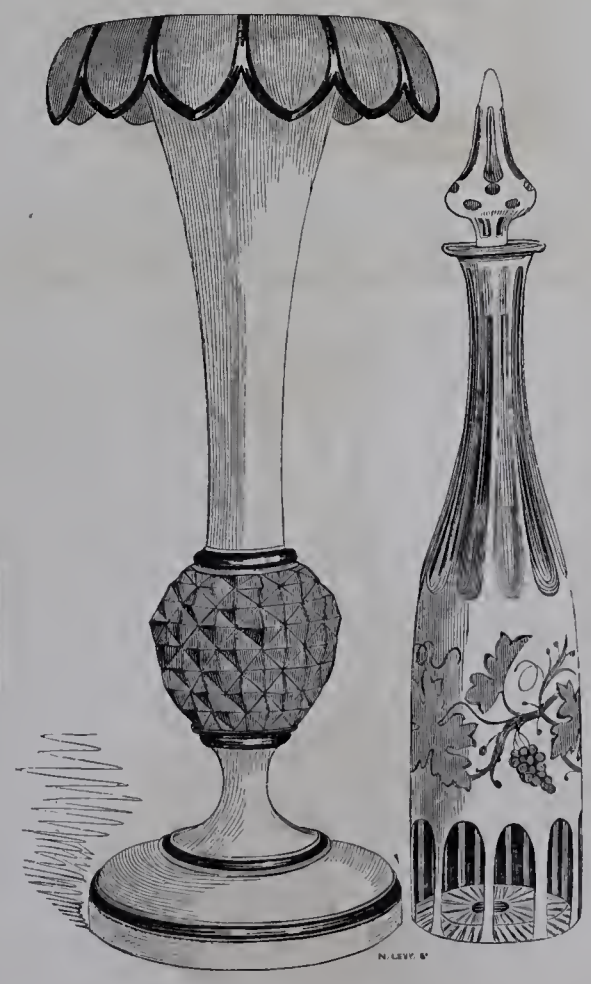


easily than the other, and by dextrous manipulation distributes it over the whole surface; or he dips the ball into a pot of colored glass, and repeats this operation until all the casings of different colors have been applied. The mass is then blown and manipulated in the usual manner, and the successive casings are exposed as the decoration requires, by cutting through them with the engraver's wheel.

Many of the beautiful articles in M. Maes' collection

are gilt. To do this, metallic gold is precipitated in the form of a very finely divided brown powder, from a solution of its chloride; the precipitate is washed, dried, rubbed up with a proper flux, mixed with oil of turpentine or gum water, and applied with a delicate brush. The vessels are now heated in a muffle, the volatile oil escapes, and the flux melts and attaches the gold firmly to the surface. When first removed from the fire, th gold is dull, yellowish brown, and lustreless, but acquires its peculiar color and brilliancy by friction of an agate or blood-stone burnisher.

The last GROUP OF TOILET BOTTLES and VASES upon the opposite page, and the VASES, &c., upon this, are from an extensive collection in the Austrian department, which has the name of E. STAINER attached to it. They are also of the celebrated glass of Bohemia, and possess its general characters. Many of these articles, however, are deficient in elegance of form, and are less tastefully decorated than could be desired.



The TROPHY of arms, &c., which is engraved on this page, is a marble bas-relief, exhibited by C. BOLLO, of Genoa.

The Guardian Angel, a statue in marble, is exhibited by L. Bienaimé, a sculptor of Rome. This is one of the most pleasing of the contributions of Italy. The good angel, in whose existence and controlling power there is scarce any one so rude as not to believe, is here visibly represented attending the young boy, who looks

reverently upwards to heed the monitions of his celestial companion.

The adjoining statue is exhibited by G. Mannetti, an Italian sculptor, resident in Dublin.

A rich and attractive display of porcelain is exhibited by Messrs. Haviland, Brothers & Co., from their

manufactory at Limoges, France. We engrave upon this page a pair of Candelabra, gaily painted and decorated in a style most unmistakably French. The

Vase, encircled with vines, and with a foliated border, though abundantly authorised by a multitude of examples, does not meet our views of appropriate

beauty. Ornaments in high relief that break the outline, and obscure the form of the objects to which they are affixed, are always objectionable. The truth

of this remark will be apparent on comparison of this with the Sèvres vases. The vignette upon the vase is beautifully painted. The COVERED DISHES are also to be found in Messrs. Haviland's collection. The figures upon the covers are in Parian, and are examples of imitative decoration.

Messrs. ROCHEFORT & SKARREN, of New-York, exhibit the ornamental SIDEBOARD, of which we give an engraving upon this page. The decorations, according to universal

custom, represent game and fish, with fruits and flowers. The material is oak, the most appropriate wood for furniture of this description, and is finished in its native color.

The group representing a SHEPHERD ATTACKED BY A LEOPARD, is exhibited by JULIUS FRANZ, of Berlin. This is one of the zinc-castings for which the foundry of M. Geiss has become celebrated. This application of zinc to monumental statuary was a discovery of Geiss, and has been carried by him to perfection. Its entire success as a rival and substitute of bronze casting is shown in this group, and still more in the noble work which stands opposite, across the area of the dome—the Amazon of Kiss. Zinc castings come from the mould in so pure and finished a state, that they require very little subsequent chasing, their cost is only one-sixth or one-eighth that of bronze, and by the Berlin process they are covered with a metallic surface which imparts the perfect aspect of the bronzes of Florence.

The three statuettes which follow are specimens of the no less celebrated iron castings from the ROYAL IRON FOUNDRY of Berlin. They have all the minuteness of detail, delicacy, and perfection of works executed in either zinc or bronze. For protection against rust they are covered with a bronze surface. The central statuette represents Marshal BLUCHER; the one on the left is a copy of a statue erected by the king, Frederick William III., to General VON SCHARNHORST; the other to General BULOW.

The BUTTER DISH of silver is exhibited by BAILEY & Co., Philadelphia.

The bronze statue engraved upon the left of this page is exhibited by H. K. Brown, of Brooklyn, New-York.

The Vase, which occupies the centre, is one of the ornamental bronzes contributed by Lerolle Frères, of Paris, whose goods we have so often had occasion to refer to in terms of praise. Its decorations are mythological, and it stands upon a pedestal of black marble.

The bronze statue on the right, to be found in the Austrian department, is the excellent work of Hans Gasser, of Vienna, by whom it is exhibited.

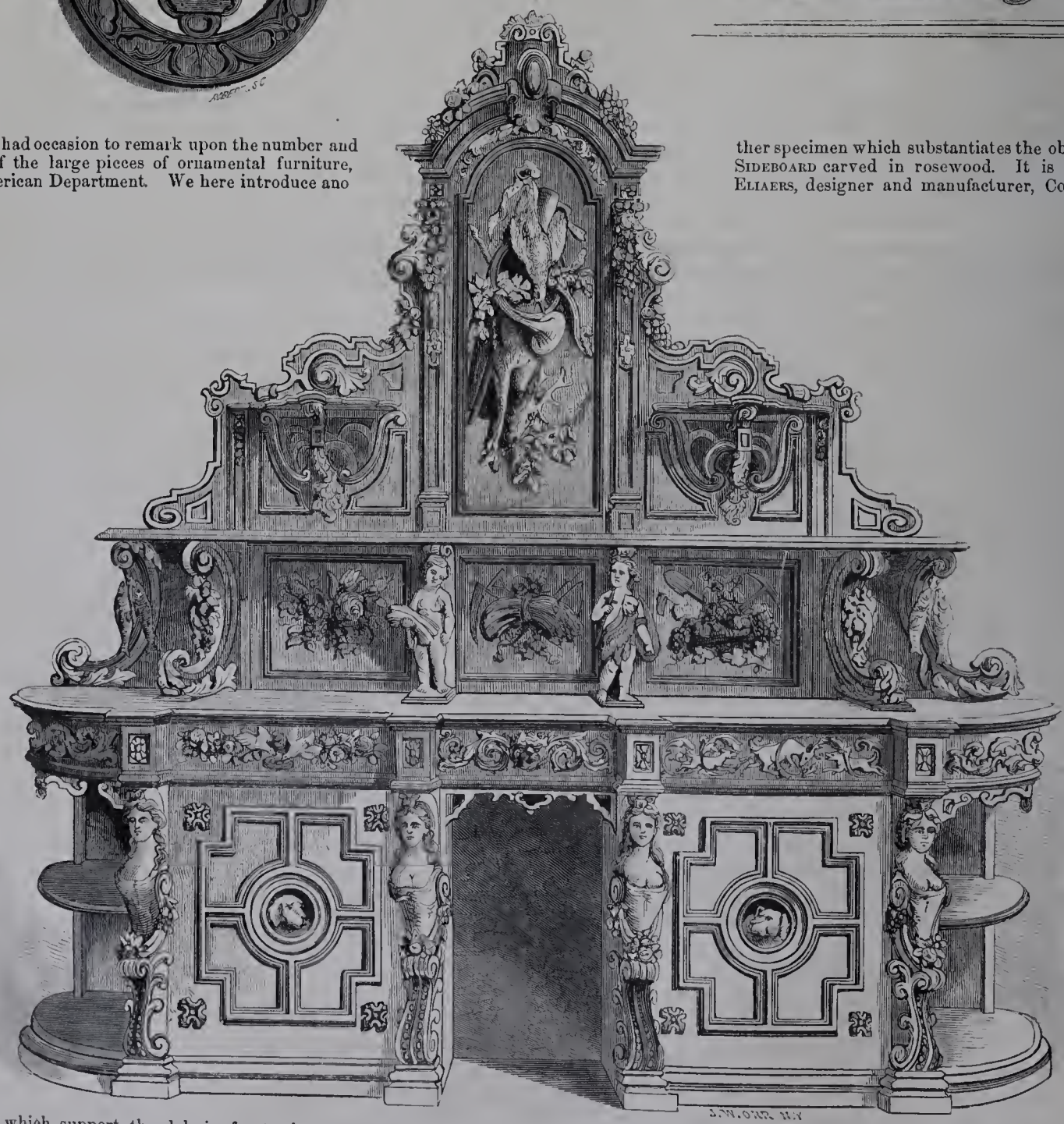
It represents Venus stepping into the bath. This is one of the most pleasing and artistically executed bronzes in the Exhibition.

The remainder of the page is occupied by the large and massive ornamental Salver, exhibited by Mr. Angel, of London. It was designed and embossed by T. Edwards, and is, we presume, commemorative of the Great Exhibition of 1851. In the centre, Queen Victoria, with the insignia of royalty, sits on her horse and receives contributions from the four quarters of the globe.

The central design is surrounded by an ornamental border in which are four vignettes which represent by characteristic figures and scenery the four continents, Europe, Africa, Asia, and America. The material in which the salver is executed is silver, the surface of which has been oxydized. The decorations are in high relief.

From various articles carved in wood and exhibited by the manufacturers, J. G. LANGE (heirs) of Oberamergan, Wurtemberg, we engrave on this page a GROUP of two figures, and a CRUCIFIXION. The figure of Christ is well carved, and is surrounded with an appropriate but not elaborate carved frame.

We have already had occasion to remark upon the number and general excellence of the large pieces of ornamental furniture, exhibited in the American Department. We here introduce another specimen which substantiates the observations then made—a SIDEBOARD carved in rosewood. It is contributed by AUGUSTE ELIAERS, designer and manufacturer, Cornhill, Boston.



The semi-caryatides which support the slab in front, rise gracefully out of the construction and adorn it Agriculture and the chase are represented by the two figures above. The panels between, and on each side, bear flowers, fruits, and grain, and the implements which aid in cultivating or in gathering them, while the arms and trophies of hunting decorate the topmost panel of all.

THE AMERICAN EPHEMERIS AND NAUTICAL ALMANAC.

STRONOMY, the complete science as we love to call it, and as it may justly be called in comparison with other branches of human knowledge, is not wanting in her representations in the Crystal Palace. It would be strange if it were otherwise. For, from the most remote ages of the eastern world, dimly lighted as they are by the faint glimmerings of traditions, or the uncertain interpretation of hieroglyphic emblems, to the period of yesterday, no science has been so thoroughly and so constantly interwoven with the thoughts, the passions, and the business of men, as the science of astronomy.

In that noble court of the building which contains the productions of the Coast Survey, and the instruments by which they are effected, are to be found telescopes. In the French gallery are exhibited sextants, quadrants, and circles; in one court is to be seen an orrery, and in another an astronomical globe or a series of astronomical maps.

The special subject, however, of our present notice is the "American Ephemeris and Nautical Almanac," and a set of new "Tables of the Moon," which may be seen in one of Mr. Putnam's cases. The casual observer will regard these books for the beauty of the typography only; but as their publication forms a most important era in the progress of astronomical science in this country, we feel bound to invite the attention of our readers for a few moments to this interesting topic. We will premise what we have to say, with a succinct explanation of the nature and objects of the work entitled "The American Ephemeris and Nautical Almanac," which we extract from a report of its Superintendent, Capt. Chas. H. Davis, U. S. N.

This work, published annually, each number of which consists of between five and six hundred pages, embraces all the elements necessary for determining at any time the absolute and relative places of the sun, moon, and seven principal planets, of many of the largest and most useful of the fixed stars, together with several different series of phenomena for the determination of longitudes, as occultations of fixed stars and planets by the moon, distances of the moon from fixed stars and planets, combined transits of the moon and certain fixed stars, eclipses and configurations of Jupiter's satellites, &c.

To these are added the places of the minor planets and their elements, rules and tables for practical use in nautical astronomy and land observations, new rules and methods whenever invented, tables of tides and geographical positions, and a chapter explaining the plan of the work and the mode of applying its various parts in practice, in which is included some elementary scientific instruction.

These details are the result of numerous, laborious, and complicated calculations. Strict and uniform accuracy is an indispensable requisite. In the case of the mariner, errors expose life and property to danger; and in that of the astronomer on the land, they cause a waste of time and labor, and not seldom the irretrievable loss of valuable opportunities. None of the precautions, therefore, that experience has pointed out for the attainment of correctness, and for security against mistake, are neglected.

The Nautical Almanac is stamped by this circumstance with a peculiar character. Unfailing precision and exactness as the absolute conditions of its usefulness and respectability. But every person of experience knows that neither such extensive computations, nor the printing of so many figures, can be conducted with entire freedom from error; and to remedy this defect, inherent in such productions, the errors detected are printed, and the corrections applied, in the subsequent volumes, probably before the former come into general use.

The calculations of the Nautical Almanac in reference to the sun, moon, principal planets, &c., are in the case of each one of them based upon our knowledge of their motions and the laws by which they are controlled, derived from the general theories of celestial mechanics, and from observations which, while they test the truth of the general theory, lead to the discovery of new facts and data, to the detection of other laws, and to the inference of new generalizations.

The observations thus employed comprise all the calculations of good authority, which from age to age have accumulated in the rich treasury of astronomical science; ending with the latest publications of existing observatories, and going back to the beginning of authentic history. In order suitably to convey our knowledge of the laws governing the motions of the heavenly bodies and regulating their more or less rapid change of place, and to put this in a form adapted to the wants and uses of the computer, numerical tables have been prepared of the sun and the planets separately, which constitute the abbreviated expressions of these laws.

The numerical tables greatly facilitate the labor of computations; they are the computer's tools of trade.

To construct these tables; to make, compile, and arrange these observations; to discuss them; to discover and investigate the theories and laws; and to invent that kind of logic, the higher mathematics, by which alone such investigations can be profitably pursued and their results succinctly defined,—have been the occupations in every enlightened age of the most illustrious genius and the most exalted talents. And a correct and well-conducted astronomical ephemeris, which comes up to the latest standard of modern improvement and discovery, is to be regarded as the full exponent of all this human thought and labor.

But from this very compendious exposition of the scientific character of the "Nautical Almanac and Astronomical Ephemeris," and of the intellectual basis on which it rests, it may be well to turn to an inquiry into its practical utility,—into the manner in which it has benefited mankind; for knowledge is always instrumental in promoting the best interests of humanity.

The primary motive for computing and publishing the Nautical Almanac was to promulgate the lunar method for determining the longitude at sea, and to furnish the requisite elements and precepts for the computation of this problem. This was as early as the year 1767. Its appearance created a new era in navigation, to which it is now acknowledged to have rendered more essential service than any thing else ever undertaken. But the old lunar method of Maskelyne was very defective, owing to the existing state of astronomical science and instruments. As the instruments of the seaman and the astronomer, however, were improved, and astronomy itself advanced, corresponding changes were made in the Almanac, which since its first foundation has always kept up with the progress of knowledge and art; if not *pari passu*, at least without lagging behind for any great length of time.

It was discovered, soon after its publication was begun, that the work was destined to obtain general circulation as an astronomical ephemeris for the use of observatories, and that it would be impracticable, even if desirable, which it was not, to separate pursuits of practical science so closely allied to each other, and so effectually promoted by the same means. In the progress of time, therefore, as the pages of the Almanac were multiplied and their contents varied to meet the wants and convenience of nautical astronomy, so the usefulness and suitableness of the work for the daily duties of observatories was increased, until it has become no less indispensable to the fixed observer on the land than to the floating observer on the sea. And this could not be otherwise. The improvement of navigation is intimately connected with, and dependent on, the improvement in practical astronomy. The security of the mariner, the advancement of the geographer, and the refinements of the astronomical observer, are harmoniously united and benefited by similar provisions.

To these considerations the "Nautical Almanac and Astronomical Ephemeris" is indebted for its present character and condition.

On the one hand, it is the text-book of the navigator. It informs him of his place on the ocean, where there are no other guides than the sun and stars. It is his intellectual rudder and compass; without it no shipmaster leaves the shores of the United States. When he loses sight of the last light-house or headland, he turns to that for his further direction.

On the other hand, it is the *vade mecum* of the astronomer, whether stationary or travelling. He learns from it in the fixed observatory how his instruments must be *set* that he may see any particular body, and what is the precise moment for observation; and in the movable observatory he turns to its pages to ascertain how, on any given day, he can best determine his latitude and longitude, the astronomical bearings of his stations, and the rate and error of his chronometer. Thus, as the tables of the Almanac owe their origin to the labors of the Observatories, so they repay the obligation by affording the most ready and complete facilities by which those labors are, at the present time, safely and expeditiously conducted.

Such are the general character and objects of a Nautical Almanac; but the American Nautical Almanac, besides sustaining this character and fulfilling these objects, will, it is expected, remedy some defects, and accomplish some special ends, which no similar work prepared in Europe is qualified to take into account.

And what these ends are may be gathered from a consideration of the isolated

position of this vast continent of North America, in respect to the other great divisions of the globe, the enterprising character of the people, and the wide extent of territory that still remains to be explored, surveyed, and settled.

This consideration makes it apparent, that neither the authorities nor standards of Europe can satisfy our demands.

In the useful arts of life, the United States have no superior, and but one rival; in the successful application of the sciences to the useful arts, the nation has already accomplished signal performances; and in the present case of a Nautical Almanac, which has been regarded as a beneficial example of such application by every nation undertaking it, the very work which consults the practical wants of the community has proved in a high degree subservient to the advancement of science and the diffusion of sound knowledge.

We learn from this same report that the American Nautical Almanac has made improvements upon the English in the ephemeris of the moon, and that of most of the planets. To explain the nature of these improvements would lead us into scientific details unintelligible to the general reader. It is sufficient to say, that they have been submitted to the leading astronomers of the world, and have received their entire approval. Indeed, as we learn from the preface and other parts of the work, Capt. Davis, the Superintendent, has associated with him several of the most eminent mathematicians and astronomers of the country. At the head of these is our illustrious physicist, Professor Benjamin Peirce, of Harvard University, the value of whose labors has recently been acknowledged by his election to the honorary fellowship of the Royal Society of London. The "Tables of the Moon," prepared in the office of the Nautical Almanac, a copy of which is on exhibition, reduce the average errors in the moon's place, as derived from the old tables, to one-third of their amount, and a distinguished gentleman of Philadelphia, Mr. Miers Fisher Longstreth, has published an improvement of the lunar formula, which has probably reduced this remaining error by two-thirds. Mr. Longstreth's corrections have been embodied in the new tables of the Almanac, and thus, owing to the genius and labors of Peirce, Longstreth, and other distinguished astronomers, the Almanac has it now in its power to predict the moon's place in the heavens with a degree of precision, far surpassing any thing heretofore attained.

It may be mentioned among the benefits conferred by these lunar tables, that they bring into practical availability a large number of "moon culminations," as they are technically called, observed by the astronomers of the Coast Survey on the western coast of the United States, which have been hitherto lost. These observations are made on the land for the nice and accurate determination of geographical longitudes, and in that now difficult and extensive field of labor are of the highest importance; owing, however, to the imperfections in the tables by means of which the place of the moon in her orbit is computed, no other observed "moon culminations" can be usefully applied than those which have been correspondingly observed elsewhere. That is, these "moon culminations," to be available, must be observed at the same date at two different places. In consequence of this necessity, some six hundred or more of the observations made in California and Oregon, to be found in the books of the Coast Survey, have been laid aside "for want of moon's places more reliable than the British Nautical Almanac can give us." (Letter of A. D. Bache, Superintendent United States Coast Survey, to the Superintendent of the Nautical Almanac, November 20, 1851.)

These more reliable moon's places, such as are sufficiently accurate for immediate comparison with observation, being given by the new tables of the Nautical Almanac, the heretofore unavailable "moon culminations" are made at once to serve their original purpose, and the determination of numerous geographical positions in our recently acquired territory on the Pacific is rendered more expeditious and more complete.

We began this compendious notice of the Nautical Almanac by saying that no science had been so engrafted upon the thoughts and pursuits of men, as that of astronomy. And this is a reflection which naturally arises upon the mention of an astronomical ephemeris, for the business of this ephemeris is *prediction*, and astronomical prediction, has throughout all periods of the world's history exercised a controlling influence upon the destinies of mankind, though in ways entirely dissimilar, and by the use of means altogether opposite and inharmonious.

It has been the misfortune, and perhaps the reproach, of astronomy that the knowledge of its most elementary facts, such as lead to astronomical prediction, has through long and obscure periods of time, been perverted to the worst purposes of superstition and tyranny.

The recent researches of French and German archæologists have shown, that the mysteries on which the religious ceremonies of the ancient Egyptians were founded, were in a great degree astronomical, or rather to use the correct word, astrological in their character. It is not difficult to conceive that this should be made the ground of an undisputed title to supreme authority.

When we remember that in this city, where education, both religious and general, is almost universally diffused, impudent pretensions advanced by offensively vulgar people, and even by some of high official and social rank, to a communication with the world of spirits, are listened to with credulity, we may dispense with any labored effort to explain the power to be derived from that knowledge which could predict the recurring phenomena of the heavens, extending apparently to an intercourse with the gods themselves. The effect upon the ignorant of the display of this knowledge would be heightened by the operation of that deeply rooted sentiment of our nature, which leads us to look upwards in religion, to see the Deity himself in the visible works of his creation which contain the most marvellous manifestations of his wisdom and power, to claim a mysterious kindred with the skies, and to endeavor to read in them the fate of men and empires. It appears that among the Egyptians, the religion of the people, the ceremonies, customs, and political institutions, and even the phases of their individual life, were connected, through a long series of ages, with celestial phenomena, in such a way that the character of the nation received its general impress from this source.

The Egyptian monuments and temples were covered with symbols and emblems of a mixed astronomical and religious signification, as for example, the royal tomb, found by Champollion the younger, in the valley of Riban-el-Moluck, and the well-known temple of Denderah. On these, the disposition of the pictures and of the religious emblems accompanying them, appear to unite an express reference to the functions of the gods to which they were consecrated, with the solar epochs they were designed to commemorate. Those hieroglyphic symbols, by which the days, the hours, the months, and years were denoted, are found on the papyrus, or on the fragments of the papyrus, containing the sacerdotal writings. Thus it seems that astronomical prediction, under the form of astrology, played a principal part in the worship of the Egyptians, and lay at the foundation of the sacred mysteries and consequently of the institutions of its priesthood.

The same mixture of religions rites with astronomical prediction existed among the other nations of the East. That it was so in Chaldea and Babylonia we learn from Scripture. And we know that it is so in China at the present day, where the hierarchy of the political system is by established usage assimilated to the order of the celestial phenomena.

The wonderful achievements of Layard at Nineveh have unveiled another instance of a religious establishment which recognizes the heavenly bodies as types of a supreme power, and ascribes to them supernatural influences. The physical character of the Assyrian plains, the climate, the pursuits and habits of the people, were all favorable in an eminent degree to the observation of the stars. An imperfect knowledge of planetary and stellar, real and apparent motion, easily acquired under such circumstances, was applied, here as elsewhere, to astrological prediction, and originated claims to supernatural agencies and perceptions.

In all that concerns this blending together the periods and symbols of astronomical knowledge with the rites, institutions and obligations of religion, we perceive the basis of learning and craft on the one side, and of ignorance and superstition on the other, upon which the supreme ecclesiastical polity of the ancients was founded.

It is unnecessary to say any thing of what history teaches us, or of what philosophy would teach us if history were mute, concerning the character of such a hierarchy, or the condition of the people over which it exercised a despotic sway.

But having exhibited astronomical prediction in the degraded state of a confederate and servant in the cause of ignorance, superstition, and tyranny, let us turn for a moment to contemplate it in its modern and better phase.

And here we behold it the handmaid and helpmate of that commerce which has made known to us the most remote parts of the earth, which has established intercommunication between distant nations, which has fostered and strengthened the ties of kindred and created anew the obligations of friendship among many people, which has brought into activity the democratic element of society, sustaining it till it acquired the mature and sedate form and constitution of manhood, which has successfully labored to plant that tree of state, the roots of which are nourished in the plenteous soil of civil liberty, and the branches of which drink the refreshing dews of Protestant Christianity.

Astrology,

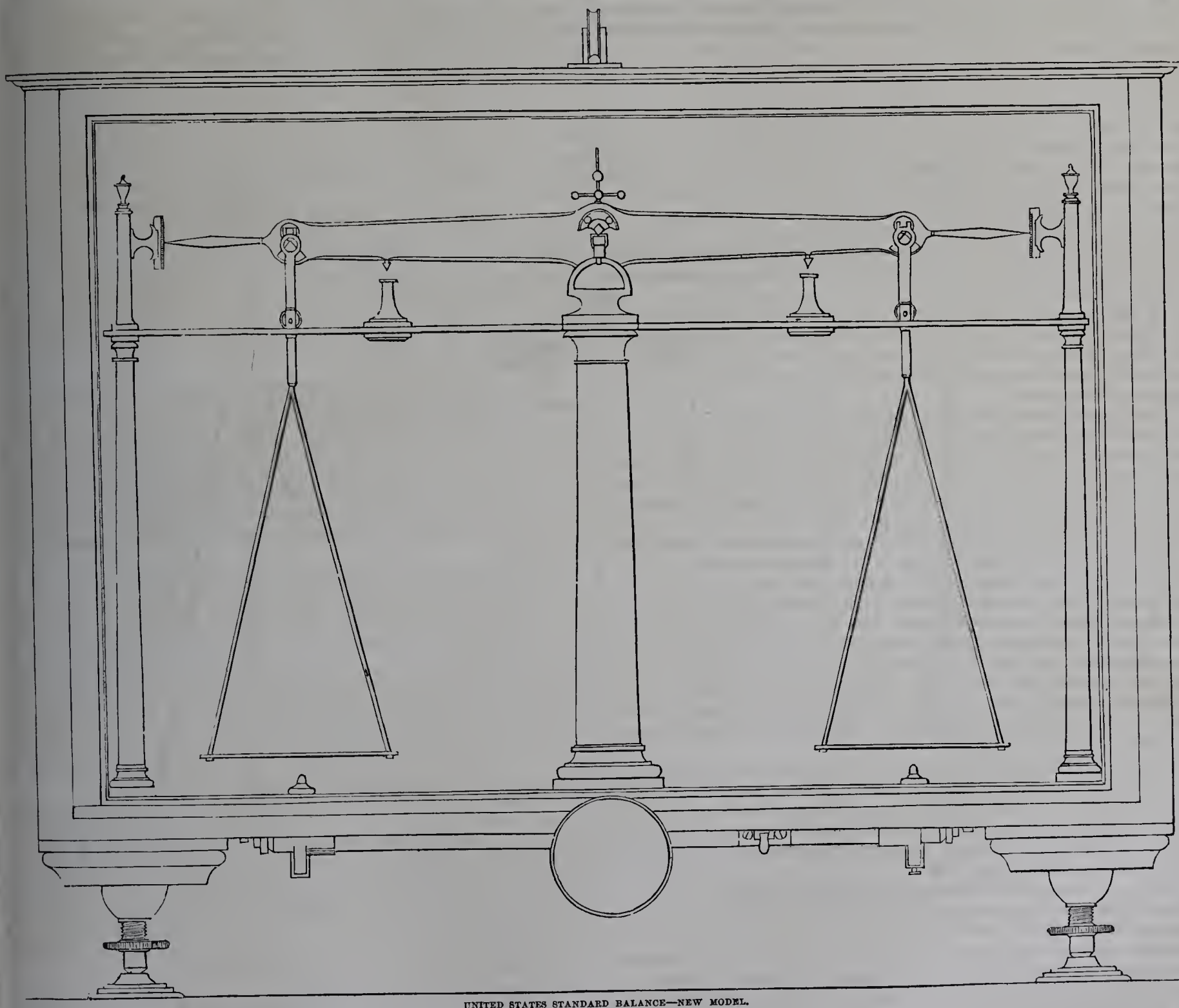
——"the gloomy form
Of superstition dressed in wisdom's garb"—

recoiled with terror from the discoveries of the seventeenth century, which laid the foundations of the modern science of nautical astronomy, the indispensable means and safeguard of our modern commercial intercourse, which in itself is the very creator of these, our modern Olympic games, the Exhibitions of the Industry of all Nations.

When we revert to those periods of the world's history in which the laws of astronomical prediction were but little understood, and even perverted in that little so as to prevent the acquisition of further knowledge, and consider our present state of refinement and superiority in this respect, we will not deny that in the modern and actual state of astronomical science, as represented in the "American Ephemeris and Nautical Almanac," we recognize one of the symbols, durable and promising, of that intellectual dayspring which hath visited us from on high.

STANDARD WEIGHTS AND MEASURES.

PERHAPS there is no collection of articles exhibited in the Crystal Palace more uniqne in itself, or more suggestive to the thoughtful mind, than the united array of French and American standard measures, weights and balances, on which so many now look for the first time. The high order of workmanship which they display cannot fail to arrest the attention of practised eyes, and not a few will see in them their real and fundamental character as legal standards of last resort. The subject of uniform standards for all species of measurements possesses peculiar interest and importance. At the meeting of the American Association for the advancement of science, to be held in Washington during April, 1854, it is proposed to discuss the questions connected with this subject, and especially to canvass the practicability of doing something towards effecting this longed-for consummation. This may excuse our dwelling at considerable length on the present theme.

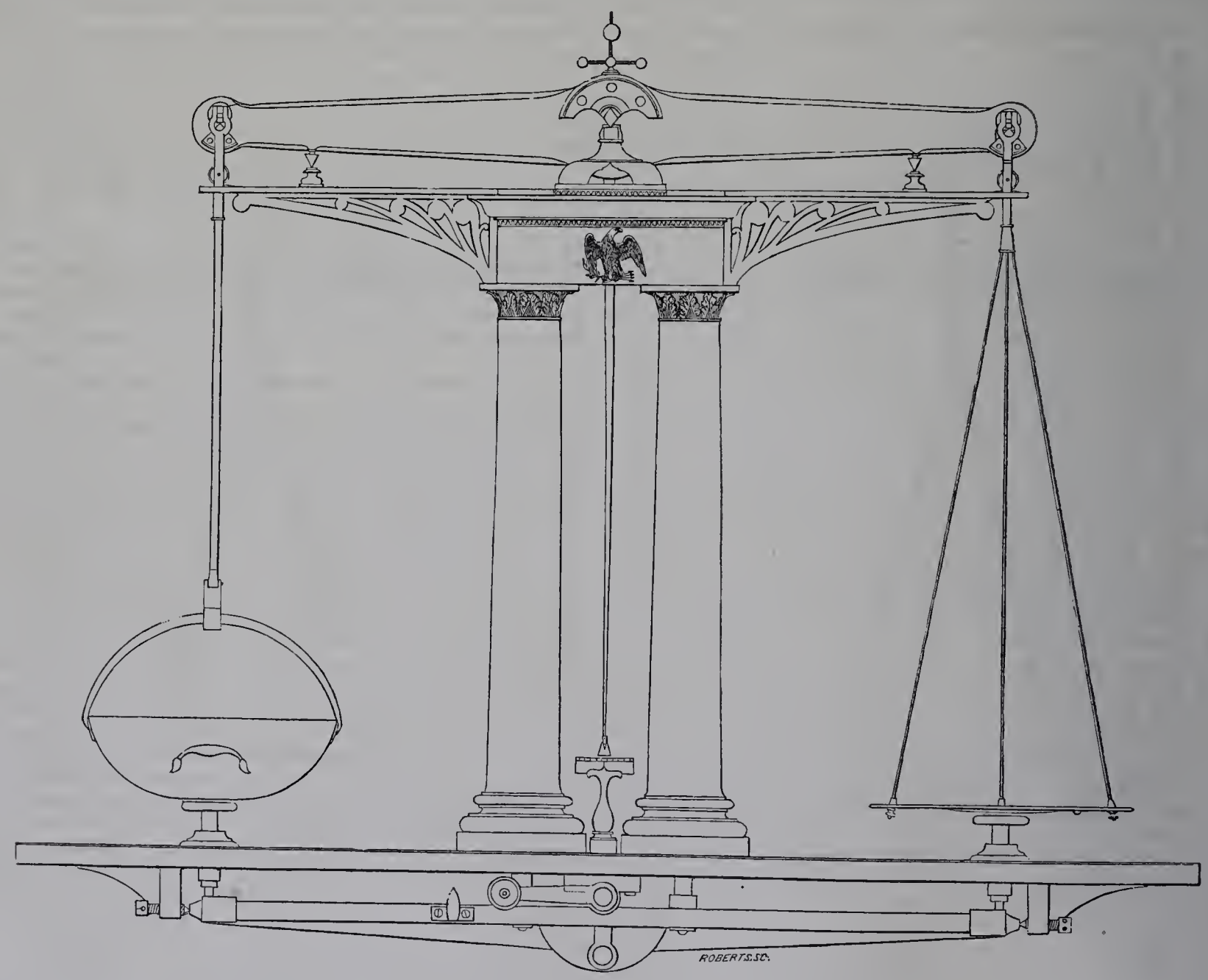


UNITED STATES STANDARD BALANCE—NEW MODEL.

We live in a weighing and measuring age. The great instauration of experimental philosophy over which Bacon presided, could have no more fitting emblems than the metre and balance. Physical science demands with an ever-increasing rigor, that all natural researches shall be made quantitative, and that statements both of causes and effects shall express amounts and intensities with scrupulous precision. Force, the unseen source of all material changes and transformations, must submit to be harnessed into close-fitting formulas, and prove by measured effects that its escutcheon rightly bears the quartering of nature's pedigree. The great triumphs of physical astronomy have been plucked down from the celestial vault, by the labor of observing ages, steadily directed to the subordination of all visible movements in the star-sphere to quantitative laws, whereby from the long past, the sky-gazer catches a prophetic strain flowing forth not in epic measure, but in that arithmetical array which distinguishes almanacs and ephemerides. The architect, the engineer, the machinist must, step by step, be asking *how much?* and ever more and more precise must be their arithmetical response. The chemist and his host of manufacturing and matter-using retainers, cannot for a moment spare that scientific court of equity, the balance, before which all deductions of theory and precepts of practice must be arrayed. Throughout all of modern life, the fruits of the soil and the products of labor, the treasures of wealth, and even the pittance of poverty, are more and more undergoing that exchange under precise valuations as to quantity and worth, which constitutes traffic and commerce. Thus are we all in our own spheres, weighers and measurers, using as referees, standards whose precision and integrity are onr sole guarantees that no error or fraud links in our transactions.

The history of the weights, measures, and currencies which have prevailed in such luxuriant multitnde among the nations of the earth, is one of a pecnliarly aggravating character. Each petty state, from time immemorial, has its own arbitrary set of weights, measures of length, area and capacity, and money denominations, commended by no special convenience or fitness, and based solely on the usage of its primeval age. We wander in a hopeless bewilderment among thousands of arbitrary units, bearing no precise relation to any natural unit of reference, very many of which are so lost or befogged as to make worthless the records in which they enter. How can we ever know the precise value of the *stadium*, the *libra*, the *jugerum*, or the *as?* How attain certainty in comparing the thousand and one arbitrary units of history with their present correlatives? And if the comparison were complete, what a militia battalion of incommensurables would the muster present! a muster reminding one of Falstaff's troops! Nothing but the massive inertia of national ignorance and pride could induce the political communities of this commercial age to bear the inconveniences incident

to such a Babel of known and conjectured measures. There is a deplorable tyranny of conservatism, a solid front of inert unreason, a lazy supplication for slumber in the endurance of bearable ills, a stupid sense of nationality, and an imperception of internationality, which rise np in leaden confronting against all thoughts and proposals of improvement, by recourse to a system of universal standards, based on direct and ever-possible comparisons with nature's immutable units. One would think that while the area of human knowledge is expanding with such wondrous rapidity, it would be esteemed a precious riddance, to relieve young memories from that heavy burden of confusing names of measures now imposed by the commercial necessities of life. Did a single universal set of standards prevail among all nations, the instruction of youth might well embrace one or two more real sciences or arts than is now possible, and commerce would be simplified to an inconceivable extent. Yet desirable as it surely is to attain a world-wide agreement in the use of one set of standards, hopeful aspirations cannot but be chilled by a view of the immense difficulties which obstruct the realization of this end.



UNITED STATES MINT BALANCE.

The first attempt at fixing a natural, accurate, and universal standard is due to that eminently sagacious philosopher, Huygens. His profound analysis of the pendulum made him familiar with the beautiful property first demonstrated by him, that the distance between the centres of suspension and of oscillation is absolutely constant in all pendnlums vibrating in equal times under equal forces of gravity. As he perceived, the correction for gravity variations with the latitude, can readily be applied with a good degree of precision. Cassini proposed a natnral unit derived from a great circle of the earth. But the time for action was still in waiting. Confusion and uncertainty of measures were to be meekly endnred throughout Europe, until the French Revolution came rushing on, deranging all the old habits of the most scientific of nations, putting under ban the prestige of the past and infusing a young life into the masses, potent enough to overpower the inertia and ignorance habitual with the toiling millions. Then at last, it became possible to resolve and to act with that over-mastering energy which was requisite to final success.

In 1790, on motion of Talleyrand, the National Assembly ordered the Academy of Sciences to establish a system of measures based on nature, and marked by no offensive nationality which could obstruct its universal adoption. England was cordially, but fruitlessly solicited to participate in this movement. The Academy had commissioned Borda, Lagrange, Laplace, Monge and Condorcet, to devise and arrange such a system. In proceeding to execute this trnst, the Commission considered the claims of three natural length units. The first was the seconds pendulum in latitude 45°; the second, the quadrant of the equator, and the third, which was finally adopted, was the quadrant of the meridian. Each of these is a natnral constant, subject to no change while the existing cosmical arrangements prevail. An absolute measurement of a terrestrial quadrant is indeed an impossibility, but its value is mathematically deducible from a limited portion, on determining a correct value of the earth's spheroidal compression; a value, however, not even yet precisely known. It seems to us that Kater's pendulum, made perfectly compensating, in vacuo, and referred to a standard locality, as Greenwich for instance, with a thoroughly compared sub-standard locality in each country, gives a natural unit, decidedly preferable in many respects to one derived from the subdivision of any possible arc on the earth's surface. A recurrence to an original pendulum unit could be had by an easy experiment, either to reconcile discrepancies, or to restore lost and to verify distrusted standards. But to recover a fraction of a meridian arc, would require a repetition of the protracted geodetic operations in which the unit originated. There would seem to be no possibility of independent determinations by the pendulum on the same spot, giving values disagreeing to the extent that nnits derived from different arc measures would. Already the original platinum metres of France, fabricated by a mercurial process, are believed to have undergone an appreciable change, attributable to a residual trace of mercury. Moreover, subsequent arc measurements show that no single arc can be correctly assumed as a standard for others, but that metres derived from different arcs would differ very sensibly, though not enough to impair a commercial unit.

How are the French standards now to be verified? By arc re-measurement, or by comparison with the Committee iron metres, or with the contemporary Academy pendulum determinations? Perhaps the pretensions of different standards may

ere long require the decision of this point, and in that case Kater's seconds pendulum at Paris ought to have a standard relation to the metre positively established, so that original standards can be made without stint or restriction. The property of the pendulum which Huygens demonstrated, that its centres of suspension and oscillation are reciprocally convertible, and Kater's simple adjustable weight, by which the pendulum can be brought to oscillate in exactly equal times when suspended in turn on the two opposite knife edges, which then represent these centres; these together, give a most exact means of determining the length of the seconds pendulum, which length for the same locality is absolutely constant.

But the merits of the several natural units became a foregone question with the Academy Commission, when they had decided to use the quadrant of a meridian, and to make the fundamental standard unit of metrology, equal to one ten-millionth of this quadrant. When the metre had thus been adopted, the plan of the Commission was marked by every excellence, and its execution exhibited the highest energy and enthusiasm, especially on the part of those distinguished men who measured the arc whence the final metre was derived. A provisional metre deduced from the Pern arc measured by Bouguer and La Condamine, was adopted for use during the great arc measurement, specially executed by Méchain and Delambre; an arc prolonged by Biot and Arago to the Island of Formentara on the South, and by Gen. Roy to the Isle of Wight on the North. When the results of this measurement so triumphantly consummated amid the disturbances of the Revolution, had been properly shaped, a new Commission of Weights and Measures was constituted, embracing a long array of distinguished names, not from France alone, but from several other European states. The list is as follows: Berthollet, Borda, Brisson, Coulomb, Darcet, Delambre, Haüy, Lagrange, Laplace, Lefebvre-Gineau, Legendre, Méchain, Monge, Prony and Vandermonde, members of the Institute of France; Lenoir and Fortin, French instrument artists; Anae and Van Swinden from the Batavian Republic, de Balbi from Sardinia; Bugge from Denmark; Ciscav and Pedrayés from Spain; Fabroni from the Tuscan Republic; Franchini from the Roman Republic; Mascheroni from the Cisalpine Republic; Multedo from the Ligurian Republic; Tralles from the Helvetic Repnblic; and Vassali from Piedmont: Lavoisier, Tillet and Meunier, were also associated. This Commission proceeded from the materials submitted to frame a thorough, unibasal, universal, and decimal system of metrology, which system was both legally and practically adopted.

The metre or unit of length is multiplied and divided by ten snccessively, to give the other denominations of length, Latin numeral prefixes being used for the submultiples, and Greek ones for the multiples in forming names, thus: *deca*, for ten, *hecto* for a hundred, *kilo* for a thousand, *myria* for ten thousand; *deci* for (0,1), one-tenth, *centi* for (0,01), one hundredth, *milli* for (0,001), one thousandth. These prefixes are used with all the basal units, thus: centimetre, centilitre, and centigramme. The *are* or land unit is ten metres squared. The *stère* or wood measure is a cubic metre. The *litre* or unit of capacity measure, both dry and liquid, is one-tenth of a metre cubed, or a cubic decimetre. The *gramme* or nnit of weight, is the weight in vacuo of a cubic centimetre of distilled water at its maximum density, or 4° centigrade. The *franc* or monetary nnit, contains five grammes of an alloy composed of nine parts of silver and one of copper. Each multiple or submultiple can be used as an independent unit: thus the kilometre is the unit in counting road distances, the millimetre for micrometric measurements, and the kilogramme for commercial weights. The Greek and Latin prefixes have only become nsage for the metre, litre and gramme, and usage only derives the *hectère* and the *centière* from the *are;* the *decistère* and the *centistère* from the *stère;* and the *decime*, and the *centime* from the *franc*.

This system, so systematical in its parts, and so well adapted to computations and ordinary convenience, is certainly far better than any other which has ever existed. It was framed in the high hope that it would become universal, and that it would pnt an end to the chaos of incommensurable and indefinable units, which has too long harassed the world. If any system becomes universal, it is clearly destined to be this one, for no other which prevails has any systematic merit, or is even entitled to be called a system. Its progress shows that this consummation is not to be wholly despaired of in the future. Already it has been legalized in Spain, France, Belgium, Switzerland, Holland, Lombardy, Modena, Piedmont, Poland, and Greece, while the Zollverein States have adopted a modification of the metre system. On our own continent, too, this system prevails in Chili and Columbia, and has recently been adopted in Mexico. Thus far has it progressed: the question now is as to its chance of gaining favor with the sturdy and conservative Anglo-Saxon nations. When we consider how commerce is yearly mnltiplying international contacts, and rendering more sensible the inconveniences arising from manifold units of measure, it seems not entirely impossible that in some way, our generic self-reliance may be mollified into a final conformity, so conducive to practical convenience. On the other hand, this very extension of weighing and measuring among the nations, will but add to the resistance which must always be excited by the temporary inconveniences incident to such changes.

In return for a complete set of United States standards presented by our government to that of France, France presented to the United States in 1852, a full set of her standard measures of length and capacity, weights and balances. M. A. Vatemère made himself active in procuring the interchange. This presentation embraced a complete collection of all the apparatus, weights and measures belonging to a bureau of verification; a brass metre, litre, and kilogramme, by Gambey, and finally, a standard steel metre prepared and verified by Silbermann, with the utmost care. Our space prohibits detailed references to the numerous items included in this gift, and we must be content with a brief discussion of Silbermann's metre, now at the Crystal Palace. This was laid off and compared by a new process and comparing apparatus of Silbermann's invention, which certainly possesses peculiar merit. It gives both a line and end measure standard metre, and the comparison with the conservatory platinum standard of France gives for its length $m0.9999774$. There is, however, reason for questioning the present accuracy of the two prototype metres of the State and Interior Departments of France. They were made from platinum, worked with the aid of mercury, which was supposed to have been wholly driven off by heating, but which is now suspected of having left a trace of mercury in the body of the bar, sufficient by its slow transfusion and evaporation to have produced a change of structure and of length. One is also slightly bent, and altogether, they are perhaps less trustworthy than their ruder iron contemporaries. One of the iron metres which Tralles retained from those made under his charge for distribution to the several members of the great Commission, was presented by him to Mr. Hassler, and is now in the U. S. Department of Weights and Measures, though it is the property of the Am. Phil. Society. This is doubtless a higher authority than Silbermann's or the Treasnry platinum metre, and we may look for some farther light on the condition of the two platinum prototypes, from a careful pyrometer comparison between the Silbermann and Committee metres.

Notwithstanding the ingennity and ostensible delicacy of Silbermann's comparing apparatus, it seems to us not equal to Saxton's pyrometer, a specimen of which very perfect instrument is now at the Crystal Palace. Silbermann's comparing apparatus professes to appreciate one ten-millionth of a metre (not the one-hnndredthousandth, as stated by Nicklès, in the January No. American Journal of Science; see his accounts in January and May Nos. 1853). Saxton's pyrometer is now so arranged that one-twenty-five-thousandth of an inch is magnified into a unit of graduation about one-fourth of an inch long, from which the one hundred-thousandth of an inch, or about one four-millionth of a metre is easily read, and this reading could, with perfect facility, be made much more minute, if desired. Whitworth's machine, which reads to millionths of an inch, is not adapted to long bars, and involves some liabilities to incidental errors, peculiarly unfitting it for verifying length standards. The truth is, that the minuteness of reading is no criterion of positive practical accuracy, for this is contingent on numerous other circumstances of condition. It is because the minimum reading in Silbermann's arrangement quite exceeds the probable degree of correctness in magnifying the motion and in appreciating disturbing causes, that it is liable to be over-estimated in respect to precision. In Saxton's pyrometer the magnifying of minute variations in length is effected in a simpler and more reliable manner than in any other arrangement now known to us, and it presents the advantage of being applicable to bars of any length, and of removing the observer to such a distance that the heat of his body is not a sensible disturbing cause. The rotating mirror is a peculiarly felicitous device, which unites nearly all desirable elements for experimenting on the dilatations and contractions of bars. Its nse in comparing and verifying the bars for Coast Survey bases, has deservedly established it as a special favorite on account of its united delicacy and convenience. Large experience in its use has not indicated any advantage from increasing its minuteness of subdivision for readings. Inappreciable changes of temperature affect it sensibly with a bar six metres long, when indeed it becomes the most sensitive of thermometers. The pyrometer has been the means of leading to a more perfect compensation for temperature variations in the Coast Survey base apparatus, than could have resulted from the use of any other means now known. It also affords the best index of the accuracy of this compensation in each base measuring tube. It is only applicable to verifying end measures. For engraving and comparing engraved lines on standards, the arrangement of Silbermann seems worthy of great reliance, as is Troughton's also.

The workmanship of the French weights, measures, and balances is not generally of that high order which might have been anticipated, though this fact will excite no great wonder, when it is known that all these articles are made by contract, and not in a government establishment. The standards for ordinary commercial verifications are only capable of insuring moderate accuracy, though for the purposes intended, this is doubtless adequate. There is in these standards a certain rudeness of aspect quite surprising to American eyes, for it cannot be doubted that in tools, implements, and utensils, American mechanics have a higher appreciation and a quicker sense of fitness, convenience, and artistic expression than is to be found in any other country. The French standard wood, sheet-iron, and tin measures of capacity for commercial verifications, are hardly equal in style to the commonest buckets in our market, and the balances corresponding, have a singular clumsiness of construction. The routine life of old communities, prevents

that bold freedom in style and arrangement of tools and common utensils which is so characteristic of our nation, not more from original mechanical talent, than from the perpetual novelty of conditions which surrouud American workers. There are many foreign tools and implements on exhibition in the Crystal Palace which an American would feel disgraced to use, on account of their manifest clumsiness and maladaptation. The axes, shovels, picks, ploughs, carpenter's tools, &c. of this country havo a neatness and elegant adaptation which we vainly seek elsewhere. The French standards for common use but illustrate the general traits of French uteusils. When, too, we contrast the truly elegant workmanship of Gambey's standards and his best instruments, with that of these rude wooden measures, the thought involuntarily arises, that this contrast is a type and perhaps an effect of the wide difference of culture and development between the highest social grade and the poor plebeian masses, in that enigmatical nation which knows how to unite the profoundest mathematical research with the lightest social frivolities. Here, where advancement is possible for all, where to improve is both nature and habit for every well constituted mind; the scythe, the wheelbarrow, the rat-trap must become the best and cheapest possible, or their critical users will learn to supersede them by some better Yankee notion. Rudeness of tools is proof that their users are not mentally quickened in their labors, and there is a fearful witnessing to masses of ignorance and unreason in those strength-wasting and ungainly implements which European laborers are content or constrained to use.

The history of weights and measures in the United States follows closely the usual type; for it embraces a time when weights and measures were essentially local, referred to no authoritative standard, and only compared in such a rude manner as to leave a broad margin of indetermination. So manifest were the inconveniencies of heterogeneous denominations of coin or currency, that in 1786 our excellent federal system of decimal money was declared, and exclusively legalized by Congress. As early as 1790, the same year in which the National Assembly ordered the great reorganization of French metrology, Mr. Jefferson broached to the House of Representatives the idea of a decimal system of weights and measures. In 1795, the President communicated the new French system to Congress in a special message, and a committee on this and on Mr. Jefferson's report, in 1796 reported in favor of retaining the foot and avoirdupois pound then in use, and of referring them to the pendulum. No important legislation followed, and the subject was left to shape itself without any provision for uniform standards. The inconveniencies of this condition were doubtless in great part obviated by the fact of our using the English units, which our extensive commerce with Great Britain must have kept tolerably accurate. In 1819, a Committee of the House of Representatives proposed to adopt absolute standards, derived from the weights and measures in common use, to obtain, through a commission, copies of the yard, pound, wine gallon and bushel, conforming to those in general use in the United States, and to procure and distribute copies of these derived standards and their comparison with and reference to the seconds pendulum and a meridian arc. The bushel and gallon were also to be defined by tho fixed lineal dimensions of a bushel and gallon of distilled water, whose weights were to be determined.

In answer to a Senate resolution of 1817, the Secretary of State, John Quincy Adams, presented in 1821 the elaborate report on this subject which so strikingly illustrates the power of his wide-grasping mind, and which became the great guide and moving force to definite, positive action. The thorough demonstration of a signal lack of constancy and agreement betwoen different custom-house and common measures then in actual use, left no room for denying the practical demand for establishing some positive standards, and of doing all that was reqnisite for insuring conformity thereto. Theso local discordances were rather of fact than of law, the legislation of different States agreeing tolerably, while the discrepancies between local standards were gross and required rigorous correction. He therefore recommended not a grand system of legislation, but rather that provision be made "for the uniformity of fact by procuring and distributing to the executives of the States and Territories, positive national standards, conformable to the law." Discouraging all attempts at fragmentary organic reforms, and leaving to a future period, the work of establishing a nniversal system of metrology, he urged the first and nearest object, uniformity of fact under the prevailing system. It is shown by his recommendation to consult with foreign nations for the future and ultimate establishment of general and permanent uniformity, that no one would have prized more highly than he, a nnibasal and symmetrical system of mensuration, had its establishment been then practicable. Such success he dared not hope, and he well knew the penalty of confusion which a grand failure would entail. Legislation on this subject still halted, the first successful movement being made by Mr. Woodbury in the Senate of 1830, for the comparison of the various custom-house standards then in use. In compliance with the Senate Order, Mr. Hassler made extensive comparisons and submitted the results in his report of 1832, a production abounding in valuable metrological materials, but somewhat deficient in digestion and arrangement. As instances of the gross discrepancies ascertained to exist among the revenne measures sent from the various custom-houses, it was found that the bushels ranged in capacity (J. Q. Adams' table) between $74\frac{1}{8}$ and $87\frac{1}{2}$ pounds of distilled water; the pounds from 6970.15 to 7075.52 grains of the mint pound, and the yards from 35.76 to 36.165 inches. In these comparisons, Mr. Hassler exhibited a high degree of skill and industry, and it is a just subject of regret that his lack of conformity or acquaintance with onr national temper and peculiarities has served to prevent his labors from attaining due appreciation, and leading to their proper effects on his reputation. He certainly achieved wonders in successfully condncting inquiries so novel among us, and withal so intrinsically difficult and laborious, without the aid of trained men to bear part.

In 1832, the Treasury Department reported to Congress the definite adoption as custom-house standards, of the following measures and weights, which are now the authentic final standards for all general government purposes, and are also the bases of all the standards distributed to the States from the Office of Weights and Measures.

1st. The fiual standard of length is a brass scale, graduated on an inlaid strip of silver into inches and tenths throughout. This was made for the Coast Survey, by Troughton, being copied as exactly as possible from the English standard of Sir George Shuckburgh, so as to secure the most perfect identity. It is furnished with microscopes and micrometers, reading one ten-thousandth of an inch, and it has a tracer arranged for transferring its divisions to copies.

2d. The standard nnits of capacity measure are the gallon and the bnshel. The standard gallon contains 58372·2 grains, or 8·3389 pounds avoirdupois of distilled water at its maximum density, weighed in air, at thirty inches of the barometer. The standard bnshel contains 543391·89 grains or 77·6274 pounds avoirdupois of water weighed under the above conditions. The mercury of the barometer is supposed to have the temperature of 62° Far.

3d. The ultimate standard of weight is the troy ponnd, copied for the U. S. mint, by Capt. Kater, in 1827, from the imperial troy pound, and only 0·0012 of a grain heavier than the British standard. This was legalized in 1828, and is nsed at thirty inches of the barometer. It is preserved in the Philadelphia mint.

The avoirdupois pound contaius 7000 grains and the troy pound 5·760, or the avoirdupois pound is $\frac{7000}{5760}$ of the troy ponnd.

In 1836, a joint resolution directed the Secretary of the Treasury "to cause a complete set of all the weights and measures adopted and now either made or in the progress of manufacture, for the use of the several custom-honses and for other purposes, to be delivered to the Governor of each State in the Union, or sneh person as he may appoint, for the use of the States respectively, to the end that a uniform standard of weights and measures may be established throughout the United States." In 1838, Congress also directed the preparation and distribution to the States of balances specially adapted for adjusting weights and capacity measures.

The U. S. Department of Weights and Measures, of which Prof. Bache is now the superintendent, is established in the Coast Survey Office, under the immediate direction of Mr. Joseph Saxton, and it usually keeps employed seven mechanicians and six laborers in the work of making standard weights, measures, and balances. These standards are intended for the supply of the States, custom-houses and mints. The full State set embraces the following items:—1st. A standard yard of brass, for both end and line measures graduated into feet, one foot into inches, one inch into tenths; also the yard into tenths, and one tenth into hundreds. It is a standard at 62° Fahrenheit. 2d. A set of standard liquid capacity measures, consisting of a gallon, a half gallon, a quart, a pint and a half pint. 3d. A half bushel standard of dry measure. 4th. A set of standard avoirdupois weights, including the following: 50 lbs., 25 lbs., 20 lbs., 10 lbs., 5 lbs., 4 lbs., 3lbs., 2 lbs., 1 lb.; also, a standard ono pound troy weight. 5th. The following multiples and subinultiples of the avoirdupois ounce, 8, 4, 2, and 1 ounces; 5, 4, 3, 2, and 1 tenths; 5, 4, 3, 2 and 1 hundredths; 5, 4, 3, 2, and 1 thousandths, and 5, 4, 3, 2, and 1 ten-thousandths of an ounce. 6th. The following troy ounce multiples and submultiples: 10, 6, 5, 4, 3, 2, and 1 onnces; 5, 4, 3, 2, and 1 tenths; 5, 4, 3, 2, and 1 hundredths; 5, 4, 3, 2, and 1 thousandths, and 5, 4, 3, 2, and 1 ten-thousandths. 7th. A set, containing the three sizes of standard comparing balances. The largest sized balance is intended to be used with weights up to 50 lbs. weight on each scale or 100 lbs. load; the medium size, with weights up to 10 lbs. on each scale or 20 lbs. load, and the smallest size with weights up to 1 lb. to each scale or 2 lbs. load. These limits can however be considerably exceeded with safety, if required. With 50 lbs. to each scale, the large balance, when in good adjustment, indicates one-fiftieth of a grain, or one thirty-five millionth of the load; the medium size with 10 lbs. to each scale turns with one-hundredth of a grain, or with one fourteen-millionth of the load, and the smallest size with one pound on each scale sometimes clearly indicates one thonsandth of a grain or one fourteen-millionth of the load under the most favorable circumstances.

The Office of Weights and Measures is steadily and systematically executing the orders of Congress, and a considerable portion of the State sets have already been distributed. The time is near at hand when each State will be supplied with authentic standards, and when it will only remain for the State governments to complete uniformity by supplying appropriate standards to each county.

The standard balances are among the finest products of American skill. Among all the tools, implements, utensils and machines aggregated in the Crystal Palace, the critical observer will hardly find any thing superior in point of workmanship to the four standard comparing balances, standing in the Coast Survey space. The

largest of these is the office comparing balance for the heavier standard weights. The drawing of it exhibits the characteristics of what is called the "New Model." We also give a front elevation of the smallest sized State balance, presenting the peculiar traits of the "Old Model." The other two balances exhibited are the large and medium sized State balances of the old model. A comparison of the two models in the two largest balances cannot but impress one with the superior grace and merit in the composition of the new one. It was a balance similar to this one which received a medal from the jury of the London Exhibition. We cannot here do better than to cite the substance of Silbermann's remarks on these balances, for few men living are as competent to judge of their merits as the modest and thoroughly scientific administrator of the Paris "*Conservatoire des Arts et Metiers.*" In a letter to M. Vattemare, relative to the American set of weights and measures presented through the latter to the French government, he says: "I will first make known to you the judgment of connoisseurs relative to the American collection, and you may rest assured that each piece has beeu well inspected and thoroughly examined. There is but one opinion as to the perfect workmanship of these articles; the two balances especially are the particular subjects of admiration by connoisseurs and the public. I cannot better testify the esteem in which I hold these balances than by informing you that I used the smaller one in adjusting the platinum kilogramme for the London Exhibition. Its constancy and sensibility are above reproach, and its delicacy is such that I can weigh with certainty to a half-milligramme. The form adopted for these balances is at once severe, appropriate for use, and impressed with that noble *coquetterie* which is only found in instruments emanating from a master hand. These are, what they are justly called, *instruments of precision.*

"What I have said of the small balance is still more strikingly true of the larger one. With ten kilogrammes on each scale, the latter shows with facility a half milligramme of difference between the two loads; that is to say, one part in twenty millions. This trial has been many times repeated, as well for my own gratification as to convince the skeptical."

Mr. Silbermann then proceeds to express his strong preference for the mode of limiting the oscillation employed in them, and to regret that the French government instead of using the same, has adopted the mode of estimating by the oscillations themselves. He highly commends the device used in shaping the American small weights, by using wire figures; thus a straight line for one, a V for two, a triangle for three, a square for four, &c. After several other points of approbation he indulges in a most natural regret over the yard measure, with its inches and tenths. Indeed, one living in the full fruition of the metre system could not but lament over such proof of outside barbarianism. Let us not despair of the better days when a universal language of metrology shall purge away the last vestiges of our motley legacy from the primeval chaos of scruples, grains, feet, ells, and barleycorns.

LATITUDES AND LONGITUDES—COAST SURVEY METHODS.

AMONG the great physical problems which have tasked the scientific energies of the last century, a high rank, both in interest and difficulty, must be awarded to the investigations and measurements made to determine the geometry and dimensions of the earth. As the earth's radius is the basis of all astronomical measurements of distance, and as the correct expression of actual distances between remote points on its surface, and also the elements of accurately projected terrestrial maps and charts, are fundamentally related to the grand results of arc measurements, a primary importance must be conceded to those geodetic operations, from which the earth's form and dimensions are deduced. The time is not far back in the past, when the earth's radius was only known "within a scantling of the truth"; but now the accumulation of accurate and comparable measurements is giving a high degree of precision not only to the value of the equatorial radius, but to the fraction expressing the earth's spheroidal compression.

The disturbing effect of mountains on the plumb line, zenith, or local level, has been repeatedly made out, and also a class of station errors or irregularities, not ascribable to any obvious surface inequalities, has been found to produce minute but very appreciable discrepancies between geodetic and astronomical latitudes and longitudes. The earth is not a sphere or even a spheroid; but its mountains and its lack of subterranean homogeneousness lead constantly to measurable inconsistencies between the astronomical and lineal or actual distances between stations. In other words, the level surface traced in its continuity around the earth, is affected with sensible departures from that particular spheroid, which would result from the general problem of a homogeneous rotating sphere like the earth, as also from that spheroid which results from a combination of all the arc measurements hitherto made. When Norwood was determining the earth's circumference, by a mixture of chaining and pacing, between London and York, whose latitudes he had observed, what would he have thought had he been told that, in the nineteenth century, philosophers would be forced to speculate on the irregular specific gravities of strata, and even be led to hypothecate huge subterranean caves, in order to reconcile astronomical and actual measurements! Now that the amount of probable error in base measurement can be reduced to six-tenths of an inch in seven miles, and that in latitudes and even in longitudes by telegraph, an error of a second of arc has become something gross, it is not wonderful that Bessel's elements of the earth's figure, or any general elements which are possible, should be found to fall sensibly short of reconciling all discrepancies. Yet it is rather remarkable that *station errors* or discrepancies between geodetic and astronomical results, amounting frequently to two or three seconds of arc, and in one instance to 9″.48, should be found belonging to points not far remote, and bearing no obvious relation to any local attractions.

The latitude and longitude of a point are but the terrestrial co-ordinates of its position, by which it is referred to the equator and prime meridian. These terrestrial great circles are usually reputed to be planes, but we doubt if more difficult surfaces ever courted mathematical skill than these very surfaces of reference. The Greenwich meridian and equatorial circumferences must be indeed curves of double curvature, and their corresponding surfaces, if traced through the earth's mass, would exhibit a most iugenious and delicate complication of minute double curvatures. It is the saine with all parallels and meridians. Yet this astronomical system of co-ordinates for positions can by no means be dispensed with,—because terrestrial positions must either be determined and defined by their use, or by the slow and laborious process of actual measurement, combined with computations necessarily involving a neglect of these same minor irregularities of the earth's form and substance. No practical inconvenience beyond the limits of geodetic discussion can ever be felt from disagreements of so minute a character, unless it be in some very transcendental age. But geodetically it is of high importance to bring out, with all possible cle rness, the exact amount by which a map projected astronomically would differ fro.n one based on geodetic elements. Of course, all maps must necessarily be constructed on geodetic projections—hence points introduced in these with their astronomical co-ordinates, are liable to be sensibly misplaced. But, if geodetic co-ordinates are used, so as to give the actual relations between natural objects, any new astronomical determinations will seem to accuse the map of error. In the British Ordnance Survey, the discrepancy of 9″.5 amounts to an inch on the scale ($\frac{1}{10.560}$) of the larger map. In the Coast Survey, the station error sometimes amounts to five seconds, the ordinary error being from two to three seconds. Are latitude and longitude, then, to mean what is so generally understood by them, or are they to refer to absolute distances? We presume that the geodetic co-ordinates must ultimately be universally adopted as the true ones, and that the difference between them and the astronomical, will be regarded as an error, for which the astronomical must be corrected. Yet the nautical community may say that as they use astronomical co-ordinates, their charts should be based on them alone. This plea would be entirely valid, if the quantity in question were not too small to become sensible in the nautical mode of observing—as in fact it is and will be. On land, a geodetic survey fixes, once for all, the positions of its stations, so as to supersede the necessity of continuing observations.

The British Ordnance Survey has recently published its Astronomical Observations at twenty-six stations, at most of which is exhibited somewhat of a station error. This has had the effect to call special attention to the subject of local disturbances. The attraction of Schehallion Mountain on the plumb line, the deviation of the plumb line through 47·8 seconds in Lombardy; the deviation of seven seconds observed in Peru; the three seconds of attraction by Table Mountain, and two seconds by Pikel Berg, observed by Maclear; aud like effects fouud in the East India Survey, had rendered quite familiar the measurable character of local attractions by mountains; but the effect of irregular densities in strata, though, of course, undoubted, had not generally been regarded as sensible or important. That it is so in fact, is now clearly seen. In 1844, Prof. Bache detected evideuces of station errors of this kind, and was thus iuduced to adopt the plan which has since prevailed in the Coast Survey, of making accurate latitude and longitude observations at a series of stations running through the entire primary triangulation, with the express view and purpose of developing these station errors, and all the facts bearing on the earth's figure. No less than 70 latitude and 46 longitude stations have already been occupied, giving a mass of observatious bearing on geodesy, the value of which can only become fully known by their publication. So far from their testifying to a symmetrical spheroid, they are laden with a series of well-defined station errors which may almost furnish an earth crust sounding line to the geologists. We long to see these results consigned to fair type, while the observers are still living to detect errors aud divine conclusions. We hope the special appropriation for this purpose, which has been twice asked, will be granted by Congress, while this subject has a fresh interest, and before the British, Russian, and Hindostan surveys have made an old story of what would now reflect so much honor on our country.

There is already a considerable store of geodetic measurements proper for use in discussing the earth's figure. The French arc of 12° 22′ comes first in order of time, and is of great value. Connecting with this, the British Ordnance arc of near 11°, between 49° 53′ and 60° 49′ north latitude, although only just published,

dates back to a venerable antiquity of origin. The greatest arc yet measured is that of Eastern Europe, which, undertaken in 1816, has now progressed so as to include 25½ degrees of the meridian from Ismail on the Danube to Fiugleness in Finnmarken. A provisional calculation of this has already been made, the Russian part of the operation embracing 20° 31′ being under Struve, the eminent astronomer, and having been throughout in high favor with the Czar. The Swedish and Norwegian portions of 4° 49′ were under the charge of Hansten and Sélander. A Southern prolongation through Turkey and the Archipelago to Mount Ida on Crete, has been talked of hopefully (though, of course, it is at present impossible), and this would make the entire arc amount to 36°, or one-tenth of the earth's circumference. The Indian arc of 21° 21′ between Cape Comorin and Kaliana, was commenced under the East India Company by Major Lambton, in 1802, and has since been extended with a liberality and accuracy which, in so difficult a country, are particularly commendable. It is hoped that this arc which has now crossed the Himalayan range of mountains may still be extended north to the Arctic Ocean, as the Russian Emperor is understood to favor this enterprise, which of course means that he is ready to provide the means for its continuation through Asiatic Russia. This would give far the longest and best conditioned arc ever measured, or even possible on the earth, being about 60° in length. We need not more than enumerate the smaller arcs measured by Lacaille and Cassini, in France; Boscovich, in Italy; Mason and Dixon in the United States; Lacaille, at the Cape of Good Hope; Condamine, in Peru; Maclear, in South Africa; and the geodetic results of the surveys of Switzerland, Holland, Bavaria, Baden, Wurtemburg, Hesse Darmstadt, Hanover, Brunswick, Upper Italy, Prussia, Austria, Denmark, and Sweden, and the British North American provinces. The United States Coast Survey has not yet published its geodetic results. Its triangulation is however connected over an arc from Portland, Me., to Cape Henry, Va., of about 7° in latitude. and 6½° in longitude. Within this range are two portions—one on the Chesapeake Bay, and the other from Nantucket to Blue Mountain, in Maine, where the triangles deviate but little on either side of the meridian. The extreme latitudes of this arc are found by a preliminary computation to correspond well with Bessel's elements, a result of the more present importance, as the Russian arc requires a diminished value of his compression. When the triangulations of all the Atlantic sections are connected, an arc of about 0°2 of latitude will be embraced, and the arcs of parallels are of unusual extent. The series of stations in this scheme of triangulation will have their latitudes and longitudes determined more in detail, and with greater aggregate precision, than belongs to any kindred operation now executed. We now propose to give in some detail, an account of the latitude and longitude instruments and methods used in this great national work.

To determine the latitude of a station, it is only requisite to measure the zenith distance or altitude of some known stars at their culmination or passage across the meridian. For approximate results, this is one of the simplest problems of practical astronomy. But where the highest accuracy is required, it becomes one of great delicacy. A second of arc being equal to about 100 feet on the ground, is a great error when a comparison is to be made with a triangulation, the sides of which are correct probably to a single foot. The measurement of angles in the meridian, on the graduated arcs of portable instruments is so much affected by uncertainties of refraction and instrumental errors, that the minutest accuracy is only to be reached by nullifying these uncertainties and errors as far as practicable. A series of careful experiments on various instruments was made by Prof. Bache, and the result has been that the coast survey observers quite concur in preferring the zenith telescope, used according to the method originated by Capt. Andrew Talcott, late of the U. S. Corps of Engineers. Trial was first made of a two-feet vertical circle, and of some eighteen-inch repeating circles, made by Troughton & Simms, and of Gamby's six, ten, and twelve-inch repeating theodolites. In all of these cases, the amount of instrumental error was so great as to indicate the advantage of adopting larger instruments. Prof. Bache then procured from Simms a transit instrument, a zenith telescope on Talcott's plan, and a zenith sector, on the plan devised by Airy for the ordnance survey, and described in the Astronomical Society notices. Telescopes of forty-five inches focal length were employed in all these instruments.

The transit, mounted in the *prime vertical* was found to give a *few* good results, but clouds so far interfered with observing corresponding eastern and western transits, as to lead to the abandonment of this instrument for field use where the results must be obtained in a limited period of time. Airy's zenith sector, after full trial, has been also essentially superseded as a field instrument by Talcott's zenith telescope. Its great weight and the excess of labor in observing with it, have caused it to give place to the far lighter and more manageable zenith telescope, which yields results with more facility and equal accuracy.

Visitors at the Crystal Palace can see, adjacent to the office of the superintendent of the building, a beautiful specimen of the zenith telescope, made for the coast survey, by Mr. Wurdeman, of Washington, and containing all the latest improvements and modifications which experience has indicated. This instrument, as it stands, is essentially American, both in its construction and in its manner of application.

To determine the latitude of a place, by Talcott's method, pairs of north and south stars are selected from the star catalogues, with opposite zenith distances of less than 25° each, the difference between these distances for any pair not exceeding about ten minutes of arc. The stars of a pair should culminate successively with an interval of from one to twenty minutes time, to provide for reading and reversing the instrument. Having thus selected and arranged his pairs of north and south stars, the observer determines approximately his meridian, and marks it with the stops provided on the horizontal limb; he then sets the instruments by the level vernier to the mean zenith distance of the pair to be first observed, adjusts the level horizontally, and waits the coming of the first star into the field. He then moves by its screw the horizontal wire, until it covers the star at its culmination. The micrometer and level scale are then read, and the telescope is turned 180° until checked by the stops, when the transit of the second star of the pair is observed in like manner by means of the same, or another horizontal wire. By comparing the two readings of the micrometer and level scale, the difference of zenith distance for the star-pair is found. The values of the micrometer divisions are readily determined with exactness by several direct methods; and the relative value of a unit on the level scale is easily ascertained, though this is usually converted into arc, and the readings applied as corrections. The effect of refraction is only that due to the *difference* of zenith distances, and its uncertainty is almost totally overcome, especially as the two observations on a pair are separated by so short a time. In the instruments now used, the probable error of a single observation is only half a second of arc, while the probable error of north polar distance for a star in the British Association Catalogue, is 1·4 of a second, though the Greenwich Twelve-Year Catalogue gives a considerable number of better positions, the probable error being only 0″·6. From this lack of precision in the catalogue position of stars, it is better to multiply pairs observed, than observations on each pair. In determining the latitude of an astronomical station of the coast survey, from twenty-five to forty pairs are observed with three to five observations on each pair. From these observations, the latitude is derived with as much accuracy as is thought necessary, though if the star catalogues should be improved, and the effect of proper motions of stars accurately eliminated, the instrument as it stands, could go considerably further with no greater labor. The actual number of observations made is such as to place the error of observation below that of the places of the stars. A full study of this subject cannot fail to establish the superiority, on practical and scientific grounds, of this American method of latitude determinations. It may as well be stated here, that this is not at all alike Ganss's method, as has been supposed by a high astronomical authority in France.

That the best mode of determining longitude differences, is wholly and peculiarly American, is a clear fact in the history of science. Though Capt. Charles Wilkes, U. S. N., made the very first use of the telegraph for determining differences of longitude, yet the labor and credit of giving practical shape and development to this method, is due to Prof. Sears C. Walker, whose recent death science still mourns. His career in charge of the department of longitudes in the coast survey, was one much redounding to our national reputation and to the advantage of science. The facility with which American ingenuity in mechanical contrivance, met the conditions for automatic clock records, when Mr. Walker had pointed them out, and the skill with which accuracy and simplicity were combined in the several recording devices of Walker, Locke, Mitchel, Saxton, and Bond, were truly characteristic. The history of the several arrangements used, the discussion of their defects and advantages, and, indeed, the whole subject of mechanical or automatic recording of astronomical observations, is of much interest and extent. To treat it intelligibly, would require much space, and is rendered superfluous by the full information easily accessible in documents and journals. When we compare Mr. Walker's last labors, in which the determination of longitude differences attains almost the accuracy of the best latitude results, with the early history of the longitude problem, in which the rude accuracy demanded by practical navigators, could scarcely be reached, we see a progress of the most conspicuous kind.

Longitude being convertible into time, the problem of longitude differences, is in fact but a question of difference between local times. How can the local times of two distant stations be compared? is the fundamental question. Simultaneous observations of an instantaneous event, like an eclipse of a satellite of Jupiter, or an intermediate signal light flash, were among the earliest and obvious modes, as the difference between the local times of observation would give the longitude difference. The transportation of chronometers between stations is another obvious mode, the value of which depends entirely on the number and perfection of the chronometers thus compared with the two local times. Again, the theory of the moon's motion being supposed to be perfectly correct, observations on its time of culmination, or passage across the meridian, would give a means of knowing the difference between the time used in computing the lunar tables and the local time. Or by observing the instant in local time of the occultation or covering of a known star by the moon's disc, and comparing this with the lunar table time for the same event, the time difference results. The modes at present in use for accurate longitude observations, are those by chronometers, by transits, eclipses, and occultations, by moon culminations and by telegraph. The lunar theory is of such exceeding difficulty and complexity, that the combined resources of physical as-

[*Continued on page* 131.

The specimens of ceramic manufactures which are illustrated on this page, are contributed to the Exhibition by the Royal Prussian Porcelain Manufactory, through the agency of the Prussian Consul.

This, like other royal and national establishments in Europe, is under the control of the government, and is supported by its funds. Its works are produced without reference to sale, and we are therefore entitled to expect a higher beauty and excellence both of design and manufacture than in private establishments, whose productions are chiefly regulated by the element of price.

The Vases, at the top of the page, are excellent in respect to form and decoration, especially in the manner in which the latter has been applied. The colors of the vase on the left are neutral, with a prevailing tint of grayish blue.

The Tea Service which follows is faulty both in form, which is quadrangular, and in decoration, the articles being entirely covered and concealed by gilding, excepting only the gaudily-painted vignettes.

The second Tea Service is better modelled, and has a very dark-colored ground, upon which there is a pleasing decoration that indicates but does not imitate foliage

A Tea Cup, prettily ornamented with sprigs imitating red coral, is noticeable for unsuitable construction, its shape being such that it could scarcely be emptied of its contents without completely inverting it.

The design and decoration of the massive Cup which concludes this page, are far from satisfying the requirements of propriety and taste. It is almost covered with gilding, and without sharing in the vulgar prejudices against the serpent tribe, we must protest against the use of reptilian ornaments on table furniture, especially such as peep curiously into tea-cups.

Mr. Carl Muller, a talented German sculptor, residing, we believe, in New-York, exhibits the group in marble which commences this page. It is called the Minstrel's

Curse, and represents the bard imprecating vengeance for the death of his son,

whose drooping form he supports with his left hand. We are not acquainted with the legend which the statuary is designed to embody.

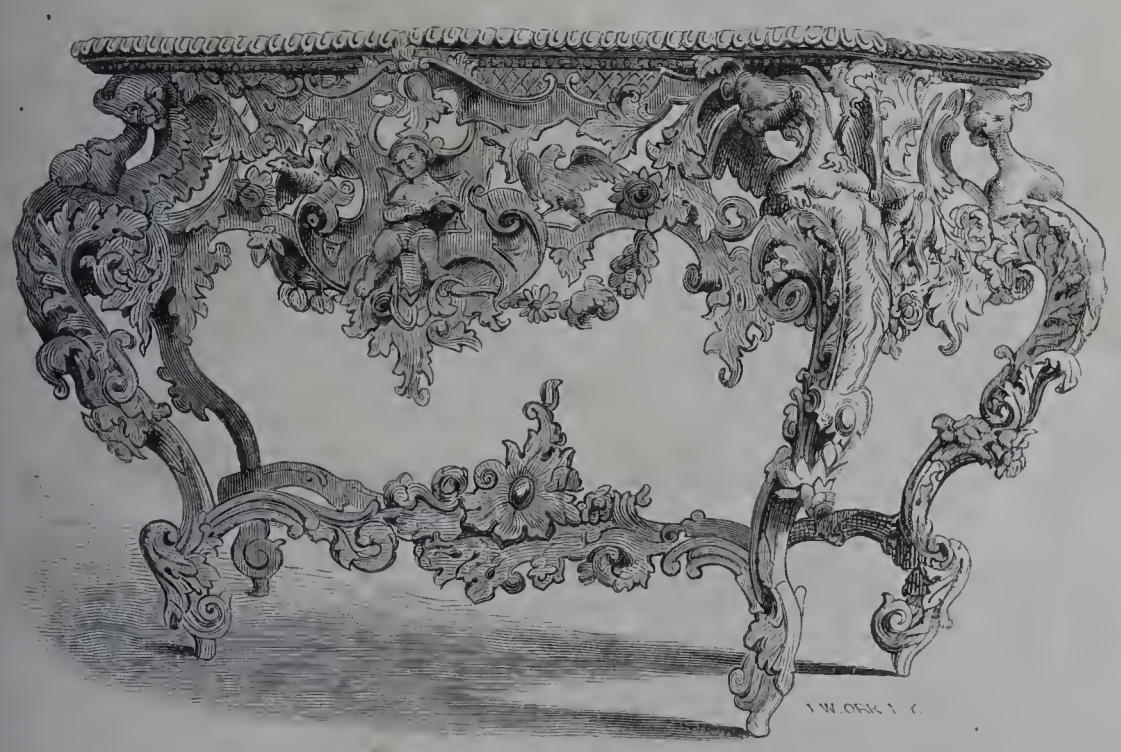
A statue of St. John with the conventional symbols attributed to him by the monks, is exhibited by Eugenio Barratta, of Carrara.

The statue of Columbus, the "world renowned Genoese," is contributed to the Exhibition by Del Medico Staffetti, of Carrara. We understand that it is copied from a model in plaster by Costa, a sculptor of Florence.

The statue called Caritas is the work of J. Ernst von Bandel. It was sent to the Exhibition from England, but was executed in Hanover.

Switzerland is rich in the number of her forests, the wood from which is turned to account by her frugal and

industrious people in every possible manner. In the winter season, in the mountainous districts, and particularly



in the Bernese Oberland, the artisans carry on a considerable manufacture of carved wood, both furniture and fancy articles, which are sold to travellers.

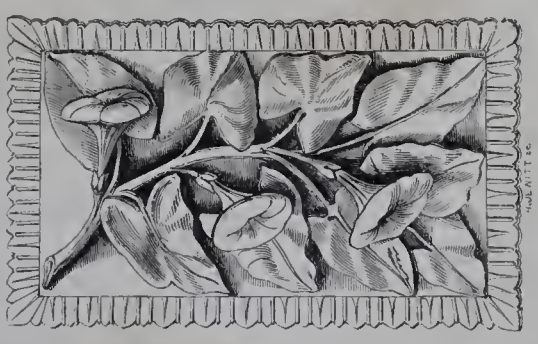
There are few who have passed through Switzerland and have not brought away some of these pretty souvenirs of their tour. We engrave some of these articles, a KNIFE, FORK, and SPOON, exhibited by KEHRLI, BROTHERS; and

COVER OF A BOX in the same material, exhibited by A. BAUMAN.

The CONSOLE TABLE, very richly and elaborately sculptured in wood, in the quaint Raffaelesque style of deco-

ration, is exhibited by G. DA FIENO, of Genoa, Sardinia.

The EXTENSION TABLE is exhibited by C. F. HOBE, of



New-York. It is made of oak, and is a substantial and excellent piece of furniture.

The carving is kept within the proper limits of decoration.

The last engraving on this page represents another

of the carved ivory UMBRELLA HANDLES of Messrs. SANGSTER, of London.

The visitor in the English Department of the Crystal Palace will not fail to be attracted by the magnificent display of silver plate, exhibited by Messrs. Hunt & Roskell, the eminent silversmiths and jewellers, of London, whose reputation and transactions are co-extensive with the world of luxury and fashion. We are happy to introduce on this and the two following pages of the Record, several choice examples of plate, remarkable in this country for costliness and artistic merit.

The Centre Ornament and Plateau, showing the application of silver to ornamental sculpture, is designed to be used as a stand for flowers, and as a candelabrum. On each corner of the plateau are groups which represent the four seasons. Of these our engraving brings prominently into view, Flora attended by her Nymphs playing with wreaths of flowers, and personifying Spring; and Winter represented by the aged Saturnus, who is seated on a leafless tree, and spreads his mantle over shivering nature; he is attended by an allegorical figure representing storms and tempests. The figures not fully in view are Summer, a female crowned with wheat and carrying a sickle; and Autumn typified by the figures of Silenus, Bacchus, and Pomona. The signs of the zodiac are placed beneath the groups.

At the foot of the central ornament are placed figures which typify the quarters of the world, each of which is attended by characteristic animals.

On the column an alto-relievo represents the evolutions of Day and Night, attended by the Hours. The stem, supporting the basket, has standing at its base four figures representing the Elements.

The whole piece is decorated with ornaments in the cinque-cento style. The design was made and modelled by Alfred Brown, in Messrs. Hunt & Roskell's establishment.

A tall silver VASE terminated with three dolphins, is embossed with the quaint

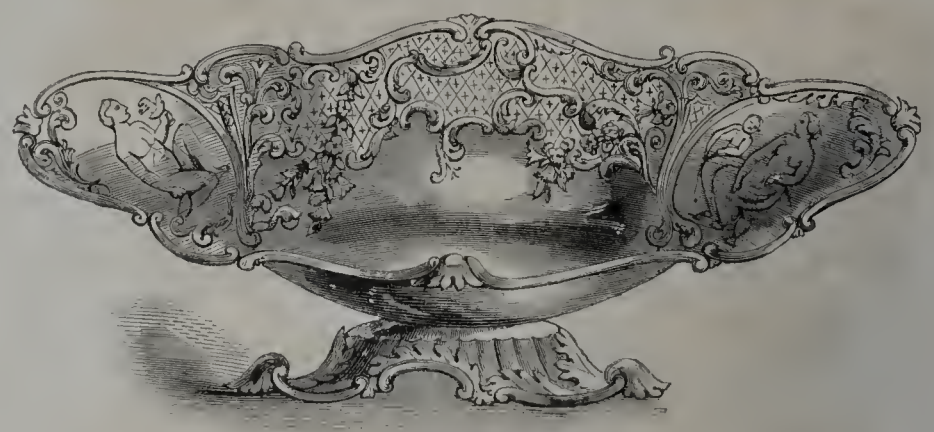
and fanciful ornaments of the Elizabethan period.

It is followed by an ICE PAIL or WINE COOLER in silver, which is decorated with female figures and an allegorical design, and has its sides pierced to show the ruby glass lining.

The VINE VASE is composed, as its name indicates, of the stems and foliage of the vine. These rise from the base, and form a beautiful openwork and border of the vase through which the ruby glass lining shows its brilliant color.

The COFFEE POT, in silver gilt, is an example of rich and beautiful decoration.

We continue our illustrations of Messrs. Hunt & Roskell's contributions by engraving an Epergne or Fruit Dish, which forms part of a dessert service. The graceful form of this piece is in keeping with the elegant uses for which it is designed. The next article is a Cake Basket which has the usual form, and is not overloaded with ornamental workmanship.



It is followed by a Coffee Pot of a similar general character. The form of this piece, and the relative place of the handle and spout deserve commendation, as showing that use has not been neglected to secure some fancied elegance.

The last piece of this collection is a Fruit Dish, the basket of which is supported by a female figure, and rests in a frame of vine branches with clusters of grapes.

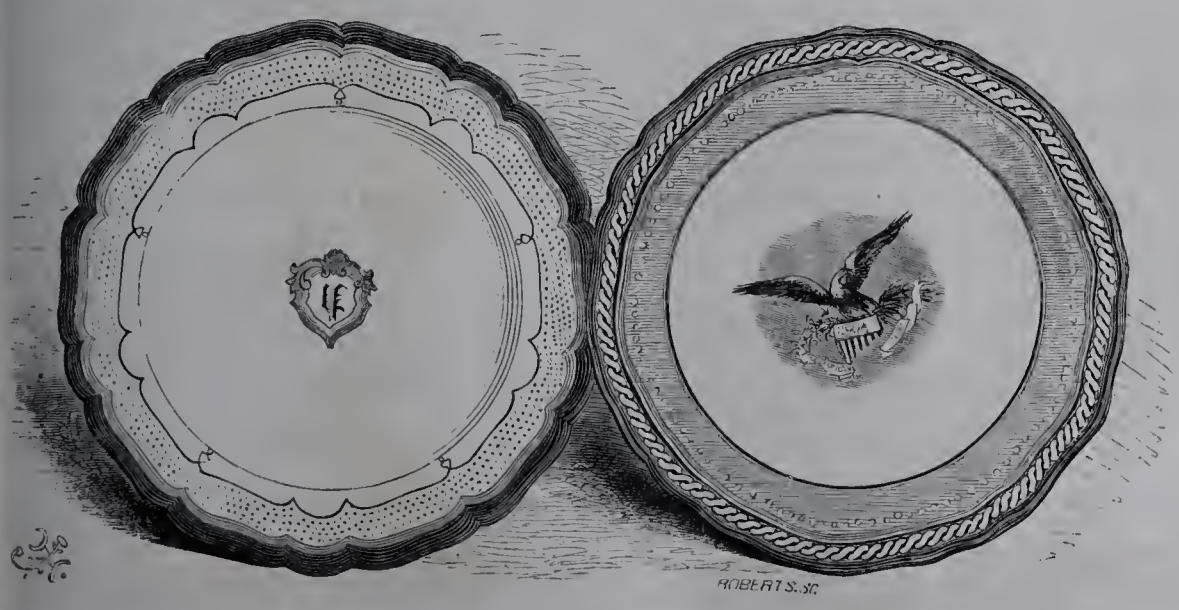
The page is concluded with two figures in a very light colored bronze. They are exhibited by Adolph Leconte, of New-York, and represent American Indian warriors executing the war-dance in their peculiar costume, and with the weapons of their savage warfare.

We have placed between them a Plateau and Ewer modelled by Guinet after the designs of Benvenuto Cellini. It is executed in Parian, and forms part of the handsome collection of Messrs. Minton & Co.

We continue our illustrations of the porcelain goods contributed by Messrs. HAVILAND & Co., of Limoges, with

the two illustrations which commence this page. The WINE COOLER is in every respect a beautiful production.

Its decorations of vines and grapes are at once appropriate and well executed, and the vignette on the side,



representing girls bathing, is painted with exquisite art.

The rich VASE adjoining, is chiefly noticeable for the richness and beauty of the purple color, forming the ground. The vignette represents a girl with a tambourine dancing with a goat.

The remaining illustrations have been selected from the goods exhibited by Messrs. HAUGHWOUT & DAILY, of New-York. These gentlemen are engaged in decorating porcelain which is imported or manufactured for them.

The designs are chiefly copies from works executed abroad, and present, therefore, no point worthy of particular remark. A PRESENTATION VASE, from the operatives to Mr. William Woram, a former partner in the establishment, bears this gentleman's portrait. Two PLATES, with the cipher of the President and the arms of the United States, form part of a service for the use of that functionary.

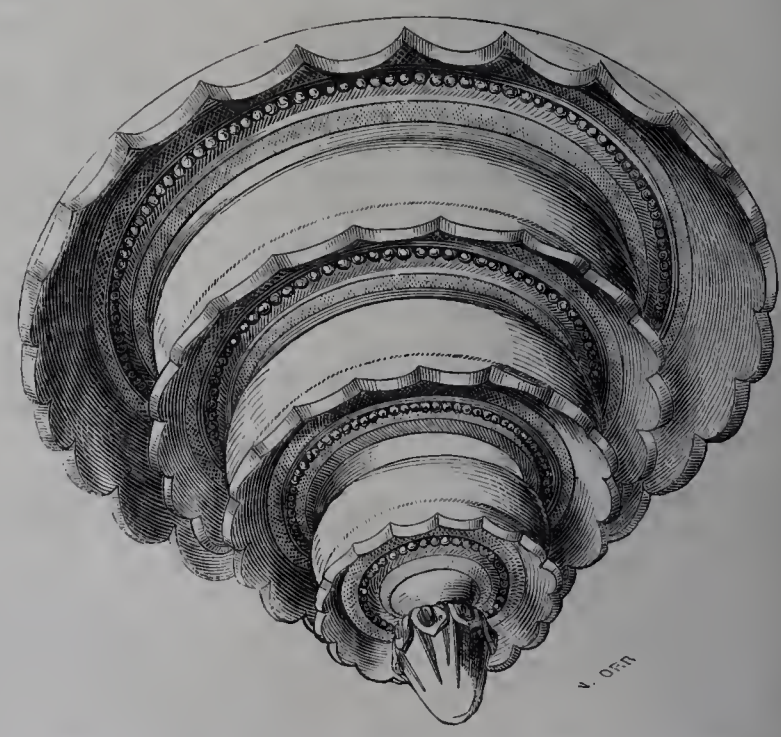
a Reaper, as is indicated by his sickle and sheaf of grain.

Two beautiful STATUETTES in Parian, gilt and colored, are exhibited by Messrs. LINDSLEY, POWELL & Co., Hanley Potteries, Staffordshire. The one on the right represents a Shepherd boy in search of lost sheep; the other,

The ornamental porcelain VASE contributed by Messrs. J. ROSE & Co., is commendable for elegance and the beauty of its gilt and painted decorations.

The remaining articles engraved on this page are among the contributions of EDWARD SAELZER, of Eisenach.

They consist of two terra cotta HANGING BASKETS, of



whose elegant uses we have already spoken, and two conservatory FLOWER POTS, also

in terra cotta. These articles are ornamented with wreaths painted in gay colors.

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tronomy have not even yet furnished lunar tables of all the desirable accuracy. Yet of all astronomical methods, that of moon culminations, when checked by corresponding and nearly simultaneous observations on the moon's position, made at standard observatories, is, on the whole to be preferred. This check effectually banishes errors of lunar theory from the results by making the time for error to accumulate very brief. Snch check observations are made for the coast survey at several American observatories, and copies of the Greenwich observations are also promptly furnished by Mr. Airy for its use. Mr. Walker gave a high degree of perfection to the method and details of reducing moon culminations. The improvements of lnnar theory by Longstreth's corrections, Prof. Pierce's investigations, and various contributions from other sources, as embodied in the new American Nautical Almanac, give hopeful promise that the time is at hand when the accuracy with which the lunar tables will predict the moon's place, may be assumed to exceed that of any single observation; a result which will make the corresponding observations at standard observatories nnnecessary.

But foremost and best of all, where the existence of telegraphic connecting wires makes it available, is the method of comparing local times by the magnetic telegraph. An astronomical clock is arranged to make an automatic record of the seconds on a fillet, cylinder, or disc of paper. The observer records the instant of observation by touching a key which governs the opening or closing of a circuit, arranged to interpolate an instantaneous record of the touch on the same record sheet which receives the record of seconds, or clock-beats. Whether the observer be in the circnit, a thonsand miles from the recording apparatus, or within touch of it, whether he telegraph transits or clock-boats, or whether the clock telegraphs its own beats, the result is that the local act of opening or closing the circuit, makes its instantaneous record at the recording station, which record being duly interpolated among the clock seconds records, can be read with great exactness, and gives the local time of the key touch exactly, save the small correction for the time of current transmission, and that for armature time. The velocity of the galvanic current has been found from many experiments, made by transmitting signals successively in opposite directions, to be between 15,000 and 16,000 miles in a second, and to depend somewhat on the conducting medium. This instantaneons interchange of signals to any extent, brings into the closest possible relation the two local times or the longitudes. Telegraphic longitude differences can be determined with an accuracy very nearly identical with that which can be given to the local time determinations. The transit instrument used in obtaining local times, gives to this element a high degree of accuracy. One of these instruments, belonging to the Coast Survey, is exhibited at the Crystal Palace. Those nsed in this work, are from twenty-six to forty-eight inches in focal length, and are constructed by Simmes of London, and Wurdeman of Washington.

On the whole, telegraphic longitude differences need scarcely fall short of the best latitude results in reliable accuracy. Thus for the first time has it been made possible to compare the astronomical and geodetic measurements of arcs of parallels in such a manner as to give valuable results. The coast survey will ultimately embrace some excellent arcs of parallels, from the discussion of which geodesy may expect some important data, bearing on the earth's figure.

To connect American and European longitudes with the utmost possible accuracy, most elaborate observations have been made by all the prevalent methods, for the purpose of obtaining the exact difference between Greenwich and Cambridge Observatory times. Great numbers of chronometers have been transported across the ocean, a single expedition, under the immediate direction of Prof. Bond, carrying one hundred and seventy-five. The accomplished director of the Liverpool Observatory, Mr. Hartnup, united in the observations neccssary for this expedition, the resnlts of which are undergoing computation, under the direction of the Superintendent, by Prof. George P. Bond. The mean result for the method by chronometers—that by moon culminations, and that by occultations, transits, and eclipses,—strange to say, agree less perfectly with each other, than the different sets of observations by each method do. The adopted longitude of Cambridge Observatory from Greenwich, based on the observations up to 1851, is 4h. 44m. 29.5s. To this point, all Coast Survey longitudes are at present referred, so that a close connection is established between all well determined points in both continents.

An incidental reference to azimuth observations, may not be amiss here. In conductiug a trigonometrical survey, the lines between stations must be *oriented* not only by latitudes and longitudes, but the horizontal angles which they make with the meridian, or their bearing from the North, must be measured at certain stations by observations on circumpolar stars. These observations are made in the Coast Survey at the primary latitude stations, with the large thirty or twenty-four inch theodolites, used for measuring the horizontal angles of the triangulation. Two methods are in use, each of which is available both by night and by day. In the first, circumpolar stars are observed during the forty-five minutes preceding, and the forty-five minutes following their greatest eastern and western elongations, the motion in azimuth being then very slow and reducible by a simple formnla. Polaris is principally, and Delta and Lambda Ursæ Minoris, and 51 Cephei are occasionally, used. Sets of about soven symmetrical observations are made at each elongation. In the second method, which is peculiar to the Coast Survey, corresponding observations, at equal times before and after the star culminates, are made in sets, which require for their reduction nothing but the taking of their mean. These culmination observations, of course, depend on an accurate knowledge of the local time or meridian, an element always necessary for other purposes at each astronomical station. A meridian determined from the fast-moving equatorial stars, by a forty-six inch transit, is exceedingly accurate for slow-moving Polaris. Errors from this source are really trifling in comparison with those which occur in referring the star to the horizon. These observations on culminations are read on different portions of the theodolite limb, and are thus free from that approach to identical readings, which exists in elongation records. This method, though new, is now much used, and is found to give results quite equal to that by elongations. The stars observed, and the arrangement of sets of observations, are the same in both. Where the theodolite is small, the star image in an artificial horizon is observed upon as a substitute for the striding level. In observing azimuths, a lamp by night and a mark by day, are placed on the same vertical about a mile off, and the star positions are referred to them in the first instance. The angle between the lamp or mark and the station is then measured, either on the theodolite limb, or by the micrometer of the telescope. Observations for both of these angles require to be so multiplied on successive days and nights, as to eliminate the effects of irregular lateral refraction. Thus at Causten's 120, at Mt. Pleasant 70, and on Jehossee Island 329 observations were made. When possible, fore and back azimuths, or those at each extremity of the line should be observed,—this furnishing a criterion of accuracy and of station errors. On discovering the general prevalence of station errors on the Coast Survey, Prof. Bache proceeded to multiply azimuth stations very much, and the fruit of this is found in the fact, that these azimuths give not merely an independent confirmation of station errors in a general way, but even afford a close nnmerical verification of their precise amounts: a result truly surprising and we believe quite without precedent. So much has thus been achieved in making out the facts relating to local deviations, as manifested in these station errors, that we grow impatient to learn from the pendulum, if the *intensity* of gravity also undergoes variations corresponding to those of its direction.

In reviewing what has now been said of latitudes and longitudes, and of the means and methods employed in determining them, we see much occasion for congratulation, in the rapid progress hitherto made in giving perfection to the ways and means for these fundamental elements of geodesy, in the liberal spirit which actuates alike republican and imperial governments to contribute to the practical development of the earth's geometry, and finally in the honorable position which not even prejudice can deny to our young nation, already the contributor to science of American methods for both latitude and longitude determinations, marked by superior simplicity, practical facility, and accuracy of results.

LITHOGRAPHY.

ALOYS SENEFELDER, the inventor of lithography, the indicator of nearly all its applications, and a man of true genius, was born at Prague, in 1771. His father belonged to the court theatrical troupe of Munich, and was anxious that his son should become a lawyer, and sent him to the University of Ingolstadt with that view; but a strong dramatic inclination on the part of Aloys fortunately led him to abandon legal studies, and to undertake, with true enthusiasm, the composition of dramas. To this occupation he joined the *role* of an actor for a time, but after a brief experience of the disgusts incident to this vocation, he devoted himself in Munich to literary labor, passing through the usual ordeal of discouragements which so constantly awaits an unknown author. A publisher contracted to make a specified payment for his works if the printing was finished at a stipulated time; but though the poor author himself worked vigorously, both at the case and at the press, the printing was not done in time, and he lost his work both of head and hand. Smarting under this infliction, he conceived the idea of dispensing with the more costly aids of printing, and becoming a free and independent author, by doing every thing himself except the buying and reading, for which he mainly expected the public to volunteer.

It is interesting to watch the progress of this brave mind, isolated by poverty, reduced to a defiant chartism in respect to mechanical ways and means, trying one expedient after another, bnt never conceiving of despair in this struggle for independence. He first invented stereotyping in sealing wax, which proved too brittle a material for the purpose. He then had recourse to the method of writing in reverse on a copper-plate etching ground of varnish, and then eating the letters into the plate with acid. But this would not do, for his plate wore away too fast. He then tried tin plates, but the acid action was found inadequate. His free recourse to erasing in these trials, consumed pumice stone to such an extent, that the poor hero's pocket grew gaunt under the expense even of this cheap material. Then it was, that his memory recurred to the white stones he had seen on the banks of the Iser, the true lithographic

stone now alone used, and his dire poverty suggested that these might replace the pnmice stone. He tried them, and with perfect success. The beautiful surface and polish of lithographic stones might have suggested to minds less acute and observing than Senefelder's, the luxury of writing on so fair a face. To him it was at once clear that copper-plates and pumice stones had no longer a right to eat out his scant substance. On the stone, as before on copper, he laid an etching ground, with a varnish composed of wax, soap, and spirits of turpentine; then, with a sharp point, he wrote through the coating and etched the finished writing into the stone. After charging these lines with an ink of linseed oil, Frankfort black and cream of tartar, he took impressions with a copper-plate press. Poor Aloys struggled on from 1791 to 1796 with the process in this forlorn condition.

In July, 1796, as a memorandum for his mother, he wrote on a stone, in the laek of writing paper, a note of some elothes which a washerwoman was about taking, intending afterwards to copy it. Before destroying this memorandum, it occurred to him to try the effect of etching it and charging it with printer's ink from a tampon. He thus in fact printed from lines in relief, and from this was led step by step, to observe that the etching was unnecessary, and so reached the practice of truc lithography. For two years he battled with embarrassments and difficulties. When in company with his friend Gleissner, a musical composer, he made the first actual application of the new art to publishing, by priuting some musical airs. In 1799, Senefelder, being pressed with work, and because his own writing was poor, employed a professional scribe, and began to transfer his writing on to stone as a labor-saving device, thus inventing autography or transferring. This fine discovery opened his eyes to the fact that he had orginated not a mere evasion by which to escape from harpy printers, but a new art, capable of manifold applications. So early as 1799 he had actually employed pen drawing, crayon designiug, point engraving, autography, transferriug of fresh plate proofs and even the transferring of old prints, the methods pursued being essentially those now practised in all their main features. Almost every application or modification of lithography now in use, was first conceived and attempted by Senefelder coarsely and with results indifferent perhaps, yet positive, and in idea, quite eorrect.

This remarkable man, overflowing with inventions, quick and versatile in his conceptions, enthusiastic and bold in realizing his ideas, but too full of genius to perfect the minuter details of his nnmerous processes, and wastiug his energies often on trials which a more thorough grasp of principles would have obviated, this poor Aloys Senefelder, had at last risen above obscurity and seeured recognition not as a son of song, but as one whose assurance of inmortal distinction, even poets might envy. He once answered a querist as to how he had made his discovery of lithography, by saying rather characteristically, "it was in writing the memoir of my washerwoman." From the time of his conceded success, he devoted his euergies not only to perfecting his art, but to the establishment of lithographic printing throughout Europe. Honors were showered upon him by kings and courts, chances of wealth were freely in his grasp; but he gave so little heed to either, that they scarcely diverted his thoughts in the least from inventive pursuits. So he livèd, devoted to originating new processes and applications, but with no more capacity than a child to direct large establishments for their practice. He applied lithography to printing cloths and paperhangings, experimented on artificial stones for lithography, invented mosaic printing, a new stereotyping process and a lithographic press, driven and inked by mechanical power. While many of his iuventions became of permanent use, many more shared the fate of his essays in directing balloons, and his solid blue for dycing cloths.

His career, so stamped with the signs and sufferings of genius, was closed in 1834, at Munich. He died, 63 years of age, honored, pensioned, and beloved, and over his grave rose a monument of Kehlheim stone; the same which once before, on the banks of Iser, flashed its white pebbles across the memory of a man, poor, struggling, resolute, and perplexed; the same which now throughout the world, gives existence to an invaluable art, whence flow forth the means of life to thousands and the means of enjoying art to human millions. When we recall the concurrence at Munich of the three things requisite for the discovery of lithography, the man, the stone, and the circumstances which directed his genius to this end, the combination seems almost to betoken evidences of that superhuman designing, so mysteriously and profoundly underlying the frame of nature and the progress of man's destiny.

Lithography was established at Munich in 1800, at Vienna in 1802, at Rome and London in 1807, and in Paris in 1814. The details of its rising fortunes, the various publications of its modes and products, the history of its most distinguished practitioners and of the most successful printing establishments, must not long detain us from the subject of lithography itself. A few leading points may well be stated, especially the various discoveries of processes by which it has reached its present condition.

Manlich, a devotee of art in Munich, among other benefits to lithography, contributed the process of printing flat tints for the grounds of pictures and for increasing their relief. To Mitteser, a professor of design in Munich, is due, not only a great practical development of crayon designing, but an important modification of the lithographic press. Rapp developed stone engraving in the shops of Baron de Cotta, at Stuttgard. But the introduction of lithographic art into Paris, the labors of Colonel Lomet, and the more successful efforts of Mareel de Serres; the burst of enthusiasm which it awakened, even in artists like Vernet, Regnault, and Isaberg; its fashion reign, when it prevailed in the Tuileries, and when the Duchess de Berry designed on stone much and well; when the Duke of Bordeaux pulled proofs, and the Duke of Orleans illustrated Gulliver's travels: this whole episode is in singular contrast with that of the washerwoman. Such a flood of favor was however premature, and Paris-like, it soon receded, leaving the process, tainted with a bad name, to suffer an eclipse of undeserved neglect. Fortunately, Noel soon began to retrieve its good name, and in 1819, Englemann invented the process for making half tints and for grading out black masses, by means of ink washes, as in aqua-tinting; a process which enjoyed much favor, though crayon shading was afterwards made to produce mueh the same results. Legros d'Anysi then brought forward the practice of transferring from copper-plates to stone, and from stone to pottery. M. de Lasteyrie had invented au autographic process by which writiugs made on a specially prepared paper, could be transmitted on to stone, and *fac-simile* printing thus becamo established. This, however, was but one, and not the greatest among his many services to lithography. The establishment of De Lasteyrie and Englemann, introduced assiduously all those improvements in the details of style and modes of work, which were indispensable to perfecting the products of an art so delicaet, and yet so facile in its capacities. Englemann gave a start and profieiency to printing in eolors, which none but a truly scientific artist and a chemist could have accomplished; hence color-printing or chromo-lithography has grown to be a principal department of lithographic praetice.

In 1819, Senefelder himself and Col. Raucourt published full treatises on the art, which proved great aids in establishing its wide practice. The superior skill and knowledge of the French in the chemistry of art generally, united with their more widely diffused taste and capacity for artistic pursuits, have together given to lithography in France, a higher tone and quality than it has elsewhere exhibited. Paris has outdone even Munich, its birthplace, and the fine prints of Berlin have been there exceeded in merit. Such well-conducted establishments as those of Count de Lasteyrie, of Euglemann, of Thierry, and of Lemercier, could not fail to produce results most favorable to the reputation of an art peculiarly liable to be traduced through the bad execution and unscientific practice of bunglers, whether artists or printers. These establishments have indeed been the best schools for training thorough adepts in all branches of this varying art.

England has also a well earned title to grateful recognition in the services it has rendered to lithographic art and practice, more especially in the landscape department. The landscape prints of Ward, Westall, Harding, Lane, and others, the works issued in rich profusion from Ackermann's immense London establishment, and many others less eminent in their claims, quite entitle England to honorable mention, not so much for processes discovered, as for making excellent use of old ones and for applying them admirably in a field emphatically her own. In France, Bavaria, Austria and Russia, governmental aid has been extended to this art for the purpose of establishing and perfecting it, and it is now among the permanent means of publishing, both prints and fac-similes, in nearly all civilised countries. It is used to an incalculable extent in printing bills, checks, scrip, and all the formal papers of commerec and exchange.

Lithography is fully capable of producing either most excellent or pre-eminently bad artistic effects. It is intrinsically a most beautiful art, and one in which artistic delicacy of touch may be made to tell most effectively. But unfortuuately it is pre-eminent in the facility with which it can be abused and perverted to the most ignoble purposes of gain. It is due to the fact that only a small capital in money, skill, or sense, is required for starting an establishment to produce the poorer kinds of lithographic trash, that taste and decency are so often outraged by forlorn caricatures, flagrant daubs, ghostly portraits, bald and blotched maps, city views through some monster bird'seye, and sooty peeps into fogland scenery; all of which are alike offensive to art and sensibility, and damaging to the reputation of that art through which they are produced. There is no effective restraint on the most desperate competition, hence style is sacrificed to cheapness until a depth of artistic turpitude is reached, too profound to tempt purchasers even among the most benighted Calibans. In our country, the diffusion of true art culture is generally assumed not to have reached that point at which the highest efforts of skill become the most productive to the artist; consequently, whatever capacity for the truest and most elaborate treatment of his subject the lithographic designer may possess, he feels beforehand that skill will neither be appreciated nor rewarded, and thus he is content to be paid for an indifferent production, on which no time is lavished to exalt his subject or his art. This policy is surely short-sighted except for mere hand-to-mouth living, and the artist who should rise to the highest style of his art, must thus soon, if not at once, secure both a better name and a higher remuneratiou. Certainly our public would now liberally buy works in a far higher style than any which lithography has yet realized among us. The extensive market which this country affords for good French lithographs, Julien's and Lassale's series of heads, the prints of Lemer-

cier and Ackermann, would seem to show that a still higher style, if offered, would prove even more attractive and remunerative.

Small as is our national allowance of lithographic art, we have even less of lithographic science. Almost without exception, our practice is one of dull routine, in which no end but wages is borne in mind. No reasoning on processes, no chemistry of materials, no perception of true art is permitted for a moment to jeopardize the main chance. From such a state of things, it is impossible that improvements should arise. A deeper policy, a nobler aim, a purer spirit must have birth before lithography can become among us any thing but a hired menial, a scavenger of jobs, a feeder on crumbs which fall as refuse from engravers' plates. The time surely must come when American lithography will manifest the attributes of a true art; when the science on which it rests shall no longer as now be ignored in its workshops, and when having discovered its higher vocation, an honorable prosperity will replace the sharkish competition now eating out the life of aspiration, and dragging down to base, sometimes the basest uses, capacities adequate to truly noble achievements. In this country pre-eminently, art needs to be democratic in the best sense, and its products to be brought within reach of the most moderate competence. Lithography is peculiarly adapted to answer this need, and under high-toned and judicious management, it might be rendered a most effective auxiliary in training the national taste to that true and critical appreciation of art, without which, sculpture, painting, and art decoration must languish in obscurity, or zigzag through that fitful galvanic life which fashion without taste, may patronize into spasms.

Lithographic stones are derived almost exclusively from Bavaria, near Munich, the quarries of Pappenheim and Solnhoven contributing the principal portion for the world. Other quarries, as for instance, those of Chateauroux, Vigan or Bellay in France, and of Corston, near Bath, in England, have been worked with some success. The Bavarian stones are, however, more perfect in their compact homogeneous structure, in their stratification, color, grain, and facility for working; for which reasons they are almost the only ones in demand. Except the largest and most perfect slabs, they are furnished at so low a rate as to leave no great margin of possible profit to induce competition. The stone is found near the surface overlaying a granite, is quarried in blocks which are split into slabs by wedges, and then shaped by stone hammers, with a peculiar acquired tact or skill, and finally the slabs are inspected critically for assignment to their proper uses. The best are used for crayon drawings, a compact, clear grain, a uniform and appropriate absorption of water, an even tint, and a freedom from crystalline, earthy or colored veins, from white spots and iron stains, being the evidences of excellence. For engraving, the hardest stones are chosen, the best color being a slaty gray, colored veins being unimportant. For pen or brush drawing, writing and transfers, general perfection is desirable, the particular shade and grain being less important. Stones are grained or polished according to their destined use. The graining is executed by sliding and whirling a second grained or polished stone on the face to be grained, with a sprinkling of sand, kept well wetted between the two faces, and a grained stone is polished by being rubbed with pumice stone. A careful adaptation of the graining or polish to the subject in hand is highly important for success, as its grade of fineness has a decided effect on the fineness of resulting tints and shades. Grained surfaces are covered over with minute granular hillocks, which rasp off the crayon, giving a peculiar feel for each grade of fineness.

The construction of the lithographic presses in common use is quite peculiar, and does not favorably impress a critical eye. It looks like a bungling relic of an unmechanical age, and it is hard to believe that it has reached its final form. Yet from Senefelder's gallows press, to that now in use, there is a long array of attempts at perfecting this confessedly unsatisfactory machine, resulting doubtless in considerable improvement, yet leaving much to be desired. The printing process is as follows: The stone being duly bedded on a solid table running on rollers, and the drawing being wetted and inked, a sheet of moistened printing paper is laid on its face and covered by some paper backers. Then the tympan, a broad sheet of leather, stretched on an iron frame, is folded down over the stone, by turning on a hinge joining it to the bed plate. Next the bed, stone, paper, and tympan, are drawn by a hand-crank movement under a fixed wooden scraper edge, which scrapes over the back of the leathern tympan, and presses the paper very strongly against the stone, by its sliding edge pressure. Thus the paper takes up the ink perfectly from the drawing. The pressure is then thrown off, the bed rolls back under the scraper, the tympan is folded out against the scraper frame, the backers are removed, and the printed sheet is stripped off from the stone. The stone is then wetted and inked, when the same round is repeated. The application of power presses to lithographic printing has thus far met with but equivocal success. Yet mechanical presses are considerably used, and by visiting Duval's large establishment in Philadelphia, or sundry European houses, the noise of steam power can be enjoyed, though it is still far from certain that the saving in time for press work is not more than balanced by an inferiority in the quality of the product. A drawing has its humors, which machinery will not regard. The good printer constantly exercises his eye in treating the paper, moisture, ink, stone and pressure; but machines have no eyes. Possibly school atlases may be well enough done by machinery, but works having any traits of art, must always, we fear, be inked if not pressed, by hand. The trials of this point made in France, are very discouraging, though better success may be possible in the future.

The theory of lithography is simple and beautiful. It is based on the relative adhesions between three materials: oily or fat ink, water, and lithographic stone. If a drawing in fat ink be made on the face of a stone, its lines adhere firmly, and if water be then sponged over the stone, it also adheres so strongly to the stone and so slightly to the ink, that a charged ink roller can be rolled heavily over the face without the ink penetrating through the water to the stone; the ink lines meantime becoming fully charged with ink from the roller. Thus by first wetting and then inking a stone drawing, all its parts take up the ink requisite for an impression, and the impression takes off this ink without removing the lines of the drawing. The order of adhesions (or of affinities, as it is often incorrectly called) is first and strongest, of fat ink to stone; second, of water to stone; third, of ink to ink, while between ink and water there is no sensible adhesion. The stone then is merely a ground from which water prints in water, and ink prints in ink, its agency in printing being limited to this service as a substratum for the ink and water. Hence it is apparent that the whole business of the artist consists in putting on the stone, in reverse, exactly what is to appear in the print, and in scrupulously protecting the remaining portion against crayon-dust, ink spots, finger marks, saliva, soap stains, and whatever else is sufficiently fatty or adhesive to print, as all such blemishes, whether visible or not, must infallibly appear in the printing.

The printer must also exercise the same protective precautions, and must guard against breaking, forcing, or filling any of the artist's work. The artists and printers are quite prone to accuse each other of faulty execution, and certainly it is necessary for each to do his duty well, in order to produce good results. The most perfect drawing may be quickly ruined by careless printing, while of course no printer can give better effects than the artist has provided for. A printer should have a good appreciation of any artistic subject in hand, as by his management of the inking, he can considerably vary the relative shade of the component parts, and can quite control the general tone of shade. He must be careful to keep the lines and shades clear, by timely sponging and washing with acidulated water and gum arabic solution, whereby the lines are prevented from spreading. The worst possible faults in printing are, that black cloudiness resulting from a spreading of the ink of the drawing, and that white, ghostly look, which results from the wearing of lines and shades, or from imperfect inking. These defects, when they become irremediable by the printer, indicate incurable deterioration, unless retouching by the artist can repair the damage, otherwise the printing should proceed no further. The number of perfect impressions which crayon drawings will give, ranges from about 500 for the finest up to 1500 for the strongest ones. Ink drawings yield a much larger number, ranging from 6000 for fine subjects to indefinitely great numbers for coarse lines, over 80,000 copies of a regimental return having been taken from one written copy in Munich, without deterioration. Transfers from copper to stone yield from 1000 to 5000, according to the quality of the drawing and of the particular transfer. Transfers from engraved stone to plane stone print about like copper and steel plate transfers. Transfers from crayon are hardly regarded as practicable, since no two stones of exactly similar grain can be found, which, however, is a fundamental requisite for identity of expression in the two drawings, as the taking of ink varies with the peculiar graining of each ground.

Few matters in lithography are more vital to success or require more care than the inks used in drawing and printing. Different receipts or variations are given for autographic ink, for lithographic crayons, for brush and pen drawing inks, for shading washes, or aqua-tints, for printing ink, for transfer ink, for relief-lined drawing ink, and for preserving ink. The necessity of varying the ink to suit all these cases, and of changing its consistency according to the special work in hand, is not only a practical deduction, but is evident when we consider how various are the functions it subserves. It is highly important, and by no means easy to procure ingredients in great purities or with constant combinations of impurities, as without this guaranty, the inferences from previous experience become inapplicable. To give precise receipts, the only ones of any value, would quite exceed our present purpose, and these may readily be found in technical works, especially in the excellent manual of Knecht and Desportes.

The paper used exercises a great influence on lithographic style. The great recent improvements in making and bleaching paper, render it quite practicable so to vary the fabric as to meet all ordinary cases, but there is always need of studying the specific conditions of a case and of carefully conforming to them. Grit, sand, or harshness will soon deface a drawing on stone; and lithographic printing paper, while it should have sufficient tooth to take the ink, should be free from these mechanical impurities—from plaster which clogs the lines, and from alum which attacks the gum on the stone and soon ruins the drawing. The sizing in paper which is requisite for strength, is quite unfavorable for its printing qualities, and the unsized paper is usually employed when it will serve, or a half-sized one when more strength is indispensable. A very high calendering or polish of the paper surface is also unfavorable, though a single calendered surface

is often used. The fibre, the whiteness, the fineness, the sizing, the calendering, the thickness, the compactness, its size, weight, age or set, strength and price, are all very variable elements, and are all important in estimating quality and adaptedness. Before printing, the sheets, in most cases, require to be well moistened.

Autographic printing is very extensively employed in Europe for printing limited numbers of circulars and other commercial papers, forms for administrative and jndicial purposes, scientific programmes and courses of instruction, and indeed for any matter of which only a limited number of copies is required. It is also considerably used for *fac-simile* writing, but as the autographic paper must be specially prepared and carefully protected from stains, as the ink too must be oily and not easy to use, connoisseurs will not find autography very inviting. In this country, at least, fac-simile copies are usually traced and transferred in pencil to the stone and then inked. In fact, autography is not here used to any considerable extent, as the job printers chiefly do the work done by the process in Europe, or else the writing is written in reverse on stone by a professed lithographer. Bonds, stock checks, ornamented cards, &c., are thus prepared to a great extent.

Engraving on stone is much employed for maps, plans, mechanical, architectural, botanical, and other outline drawings. The lines, scratched into the stone with a point, lack the clearness of copper lines, or even of pen lines on stone, yet with care, decidedly fine drawings can be thus executed. As these engravings give proofs adapted to transferring, there is almost no limit to the numbers which can be obtained from a well engraved stone. The engraved lines take the ink less readily than drawings or transfers, hence the printing of engraved stones is usually quite to the prejudice of the ink lines produced, done from transfers, if considerable numbers are desired. The ruling machine, and, if in skilful hands, the etching process, may be made to co-operate with the graver to good effect. Engraving on stone for maps, for botanical illustrations, &c., is much used in Germany and France, as its cost is only about 30 per cent. of that for copper engraving, and as from 10,000 to 12,000 may be printed from one stone without deterioration. The "Flora of Brazil," contains 1,700 plates thus engraved by Knecht. The chief difficulty is in procuring the *printing* from engraved stones. Engraving in relief is a delicate and critical etching process not much in use. It is, in fact, but a modification of Senefelder's first discovery, and does not admit of snfficient relief to print in the manner of wood-cuts.

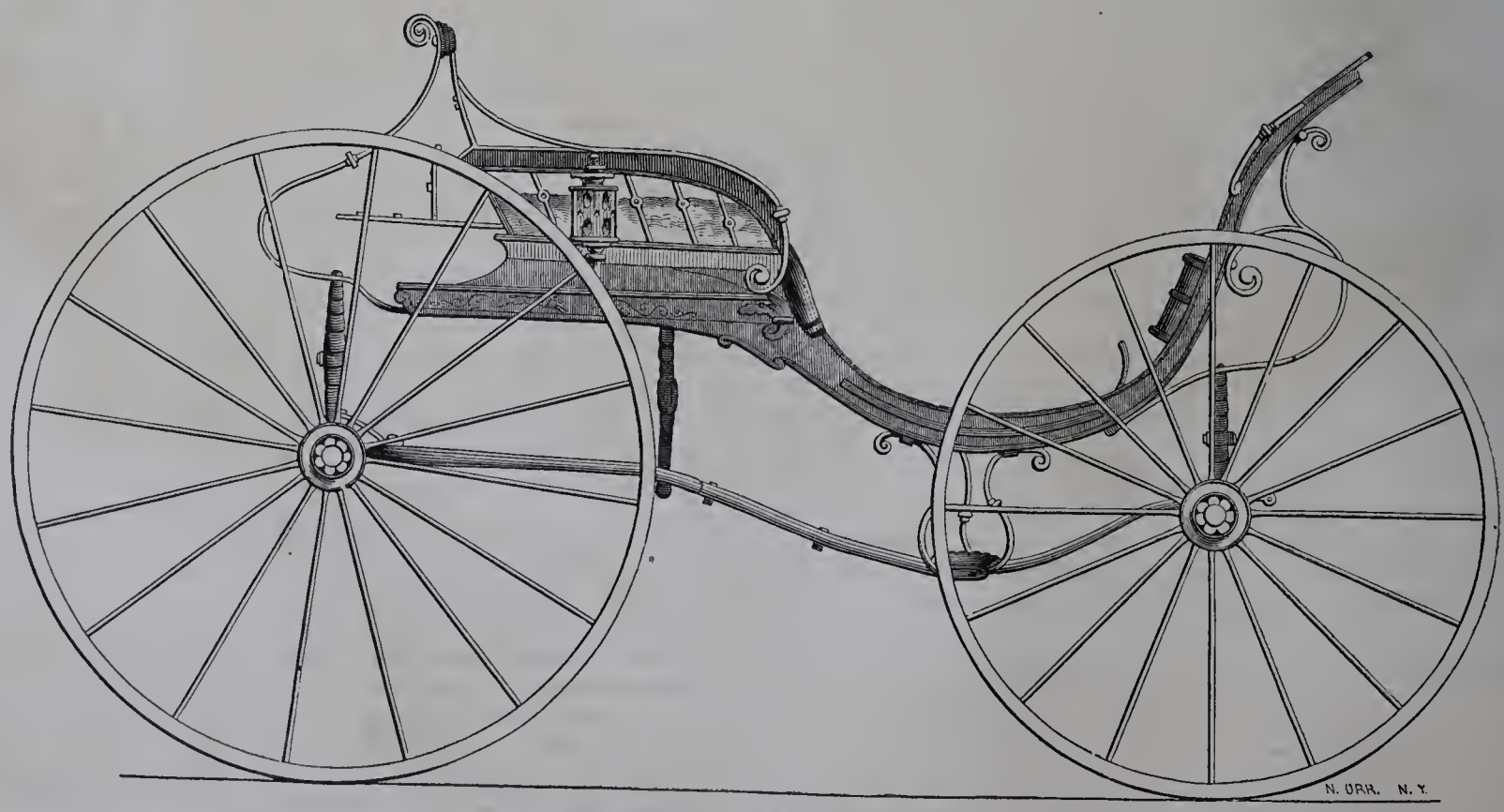
Crayon designing consists simply in drawing on stone with a fat crayon. But this simple process requires more precaution, more acqnired skill, more delicacy of touch than one can readily conceive, and the artist must carefully watch the grain of the stone, its thorongh protection, the working of his crayon, and a multitude of minor things indicated by experience. He must guard against the need of erasures, and as far as possible avoid retouching. Withal, he must be an artist, realizing the exact effect of what he is doing. The style in *two crayons*, now qnite common, was used by Manlich in 1805, and revived subsequently by Harding in his Swiss and Italian views. For this the stone is prepared so as to print a uniform tinted ground, on which the dark crayon drawing is overlaid and the white crayon lines and lights are made by erasing the ground tint, and scraping away the grain more or less completely, sometimes even hollowing out the brightest lights.

Several processes of *grading shades* or of aqua-tinting have been used, of which Senefelder's, Jobard's, Hancké's, Knecht's and Lemercier's are the most conspicuous. None are quite what is desirable, nor is it likely that any process can reach the main difficulty, which is that printing soon impairs or varies the most delicate shades. Lemercier's seems the simplest possible. When the crayon or ink drawing is ready, scatter crayon-dust over it and brush it with a soft brush, so as to give the shade required; then retouch with the crayon ink or stamping crayon, until the desired tone is reached. He has used this process in chromolithography, so as to save some of the color-printing stones. The principles of *pen and brush* drawing on stone are so like those of crayon, that it will suffice to mention them and their great utility and convenience for many varieties of work. They require special practice, study and manipulation.

Chromolithography is the name given by Englemann to his process (an expansion of Senefelder's idea) for printing from several successive stones, a series of colored inks, which, by their combination and snperposition, realize the final design in the colors desired. The great difficulty, aside from the procuring of good color inks, is in securing an accurate register or superposition in the successive printings, so as to preserve the correct relations of the various colored lines and masses, a difficulty increasing rapidly with the size of the print. The drawings of the parts for each color-stone are made by tracings, and the effect of their relative intensities, superpositions, and contrasts must be realized by study, practice, and special comparisons. The difficulties of this process are only great when the lines of tint are complicated and delicate, but ordinary tint printing and gilding are not peculiarly trying.

Copper or steel plate *transfers* are made by first taking a plate impression in transfer ink, on a paper prepared by a coating with a soluble layer usually composed of starch, gum arabic and alum. This impression is laid face downwards on a clean stone, run through a lithographic press and wetted on the back. The paper is then stripped off, leaving the ink adhering to the stone. The starch layer is duly washed away, when the transferred ink of the plate impression alone remains on the face of the stone, which is washed in acidulated and gum water as usual, and is then in condition for printing. Transfers from engraved stone to stone, from autographic writing to stone, or from letter-press to stone, are all conducted on similar principles. Transfers from steel and copper plates are very extensively used for printing maps, atlases and checks.

These are the chief lithographic processes, on which much more might be said, except for the prohibition of space. They all exist among us. They are all represented at the Crystal Palace. We must not venture on specifications of merit or demerit in the specimens there exhibited, but the foregoing general summary of lithographic history and processes may provide others with somewhat better means of appreciation and criticism. We thus leave the subject, hoping that we may live to see lithography so far advanced in America, that our products in this beautiful art can safely count comparison with the best specimens from Paris and Munich.



LIGHT CARRIAGE; BY R. M'KINSTRY, NEW-YORK.

FLAX AND HEMP BREAKING AND CLEANING MACHINERY.

ONE great obstacle which has always been encountered in the preparation and manufacture of hemp and flax, has been the want of suitable and effective machinery for cleaning out, or separating the fibres from the *boon*, or woody portion of the stalk. The labor of gathering, or pulling flax, and of dressing and breaking both flax and hemp by the old and established methods, has been so great, and attended with so much waste and trouble, as to discourage alike the farmer and the manufacturer. The number of machines and devices for breaking and preparing flax, which have been brought forward in Great Britain and on the Continent since the commencement of the present century, has been almost innumerable. One can hardly open a number of the old and once famous Nicholson's Journal, or in later days, the London Mechanics' Magazine, or the Repertory of Inventions, without meeting one or more extended descriptions of such machines. In the United States, on the contrary, owing to the neglect of the flax and hemp manufacture, comparatively little attention has been given to the subject until within a recent period.

We import linen goods each year to the value of ten millions of dollars, although we have more productive territory unemployed than any other nation, and produce a vast amount of flax for the seed only. Public attention is now directed to this great branch of agricultural and manufacturing industry, and as a consequence of it, a large number of new flax-breaking machines have been brought forward from almost every quarter of the United States.

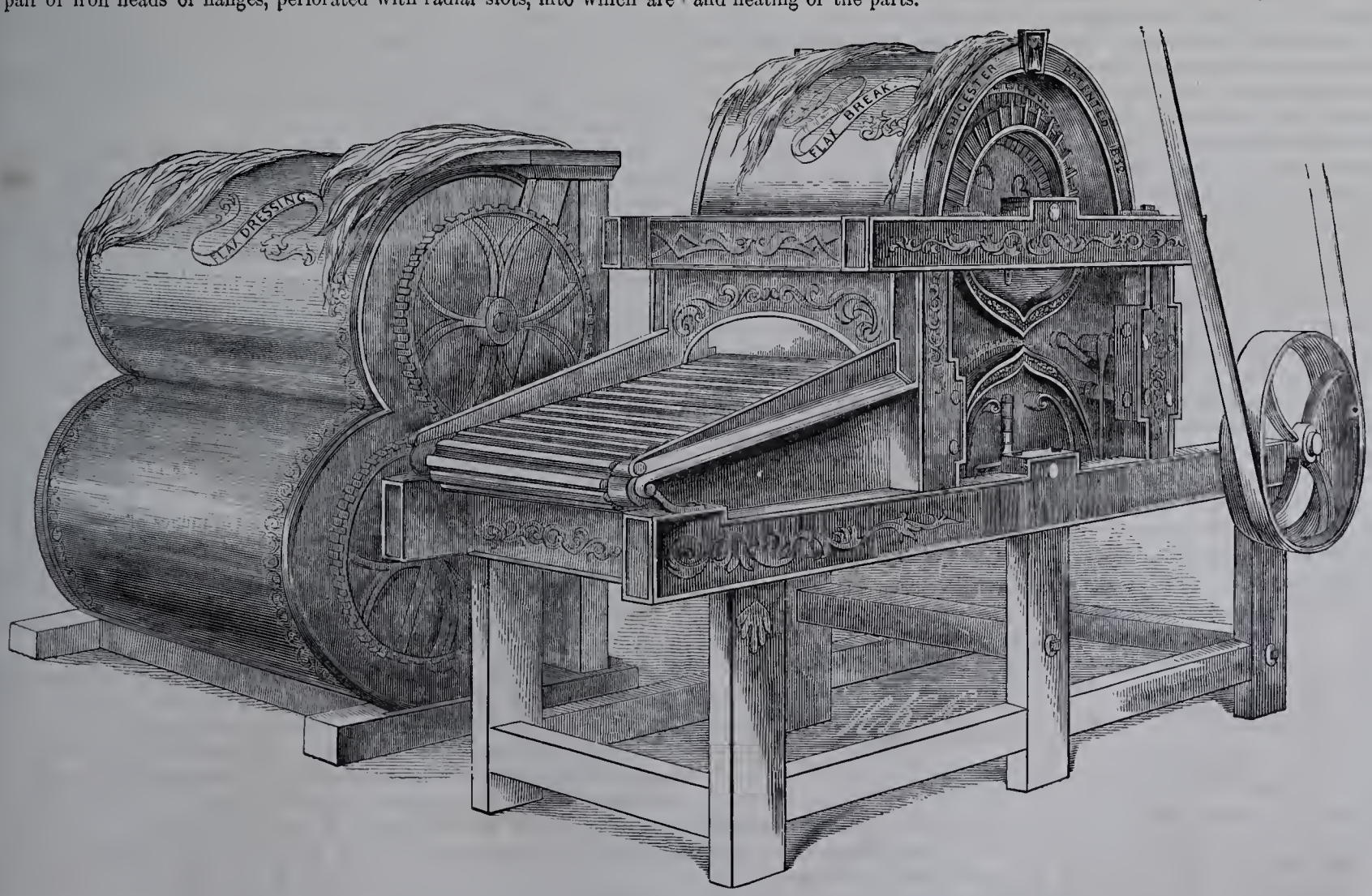
One of the best which we have yet examined, is now on exhibition in the Crystal Palace, and is faithfully represented in its general aspect by the annexed engraving. It is the invention of Lewis S. Chichester, of Brooklyn, N. Y., and is ingenious and simple in the mechanical combination and movement of its parts, and at the same time, thorough and rapid in its action on the material to be broken. The mechanical arrangements of this machine are as follows:—

It is furnished with a feed-table, over which the material is spread out, and conveyed between a pair of iron calender rollers, which flatten and split the stalks lengthwise, as they are carried through a pair of iron fluted rollers into the bite of a pair of large breaking cylinders. These form the body of the machine, from which the material is delivered upon a receiving apron, in a mass or sheet of fibre. The two breaking cylinders are each formed by securing near the opposite ends of a shaft, a pair of iron heads or flanges, perforated with radial slots, into which are inserted breaking plates, or ribs of iron (wrought to a smooth edge on top), which are free to move in and out, towards or from the centre of the cylinder heads, as they are guided by springs and cams; these last are arranged in such a manner, that the ends of every other plate or rib in each cylinder project through the radial slots in the cylinder heads, and rest upon stationary cams, placed outside of the heads, while all the intermediate plates or ribs rest upon spiral springs, supported by circular flanges, keyed on the shafts just inside and close to the cylinder heads. These flanges are perforated with holes forming sockets on their periphery, to receive and support the spiral springs, and to admit the iron pins which pass through and sustain the springs, which are fastened, or locked to the under edge of the pressure plates or ribs.

As the cylinders revolve together (one being placed over the other), the cam plates, or ribs of the lower cylinder are guided upwards, and meet and carry back the spring or pressure plates of the upper cylinder; at the same time the cam-plates or ribs of the upper cylinder, are, in the same manner, guided downwards, and meet and carry back the pressure plates of the lower cylinder. The ends of the plates are left thick and rounded off, so as to form circular bearings for the opposing plates or ribs in meeting and turning out; the edges of the plates, on the contrary, are left quite sharp and very smooth.

The cylinders of this machine, in their operation and action upon the material, were designed to copy the movement of the hands in breaking out a stalk of flax between the thumb and fingers. The action in this instance is that of slowly moving the hands backwards and forwards in opposite directions, allowing the flax at the same time to slip through the thumbs and fingers under pressure. In this way the stalk is most perfectly broken, and the woody portion separated from the fibres of the plant, each line of fibre being preserved perfect throughout its entire length, and delivered ready for the process of dressing or swingling.

The power required to operate this machine is said to be small (one horse-power, according to the inventor, being sufficient). The movements are all very slow, but continuous in their action—the working parts being distributed over the surface of the large cylinders, which make but three or four revolutions per minute. This rate of speed is sufficient to break a ton of flax straw in a day. The slow motion of the cylinders obviates an objection which has been raised against some machines for cleaning flax, viz., that they do their work with rapid motions at one point, consuming power, and subjecting the mill to danger of fire from friction and heating of the parts.



In addition to the above described machine, Mr. Chichester exhibits a new hemp and flax-dressing machine represented in the engraving, which also merits attention. It consists of two conical cylinders, formed on parallel shafts, which revolve towards each other, and are driven by a pair of gear-wheels fastened to shafts outside of the frame. These cylinders are each formed of four large, conical, spiral blades of wood, secured to flanges of iron; these are keyed to opposite ends of the shafts, and placed over one another, revolving with equal motions in contrary directions. In this way the blades of the one cone are always opposite to the spaces between the blades of the other. The cones are covered in front and behind with a wood or sheet-iron casing. A slot is cut through the front casing, along the bite of the cones, and a suitable trough formed in the casing opposite (on the back of the machine), with an opening to carry off the wood and other impurities dressed

from the mass. These casings and openings are so arranged as to control and direct the currents of air towards and out of the opening in the back of the machine, at the small, or feed end of the cones or cylinders, opposite to where the operator (holding the mass to be dressed in his hands) first introduces it to the action of the dressing blades through the slot in the front casing. These blades draw in the mass, striking first on one side and then on the other, nearly at right angles with the line of the fibre, beating out the wood and impurities, which pass off through the opening behind. The mass is then moved along the slot towards the other end of the blades to be finished.

The conical and spiral form of the blades cause a gradual change in the direction of the blows from the feed end, where the blows fall at right angles to the direction of the mass, towards the finishing end of the cones, where the direction of the blows is nearly lengthwise with the line of the fibre. At the feed end the blades are left very blunt and rounded off; towards the finishing end they change gradually to a sharp edge. The severity of the blows is also increased as the radius of action increases towards the larger end of the cones. With this arrangement, also, a larger space is left at the feed end for the mass when first introduced filled with shives, which gradually diminishes as the mass is cleaned and diminished in bulk. Also with this arrangement at the finishing end, the heel of the blades is thrown out nearly on the circle of the edge, on which hackle teeth or brushes can be placed if desired.

This dressing machine is claimed to produce but little tow, and to be entirely free from dust; its capacity equals the flax and hemp break of the same inventor, dressing out the straw as fast as it is broken.

The old methods of swingling flax and hemp are exceedingly rude and imperfect, and at the same time wasteful in their action. In Europe the plan generally pursued is as follows:—A large handful of the material is grasped in the left hand and held over the edge of an upright board of a suitable height, and beaten with a large wooden sword or knife, held in the right hand. The blows being given in the direction of the line of the fibre, the broken wood or shives are driven downward, tearing through the flax or hemp, creating a large amount of tow, and over-dressing the outside which receives the blows intended to act upon the interior of the mass. When power is used to perform this work, the same principle is involved, and the same objections present themselves. In this case a number of dressing blades are fastened to a shaft, and set in motion in such a way as to revolve near a slot cut in an upright board. Through the slot, or opening, the mass is introduced, and spread out to the action of the revolving blades.

In addition to the above machines, American ingenuity has taken a new direction, for which, we think, there has been heretofore no pattern or example—we refer to the flax-pulling machine. This invention, which, on account of its large size, is not placed upon exhibition, is designed to pull flax, and lay it on the ground, as rapidly as grain is gathered by the ordiuary reapers. Its construction and operation is as follows: A horse is harnessed into the machine, moving it before him, and the flax is pulled and laid upon the ground in such a manner as always to give a pathway, and leave an ample track for the wheels. In the forward movement of the machine, the flax is separated and collected between long wedge-shaped projections, forming a breast or front near the ground. The flax is then pulled by means of vertical rollers, furnished with arms, and reaching forward underneath the branches, or seed tops of the flax. The stalks are thus, at each revolution, bent over nearly at right angles with their growth, the lower portions being brought into the bite of the vertical rollers, ranged just back of the wedge-shaped projections, and delivered on the gronnd in rows, ready to be gathered into bundles. The rollers are driven by gear-wheels, on a shaft receiving motion from the two large wheels, to which the whole frame is adjusted. The flax-puller has some advantages over the grain reapers, in the fact that it contains no knives, or cutting edges to be sharpened, and from its great simplicity is not liable to get out of order. The flax-puller is also the invention of Mr. Chichester.

If all the above machines prove as efficient and valuable as is expected and claimed, they can hardly fail to exercise an important influence upon the flax indnstry of this country.

ROYAL MANUFACTORY OF THE GOBELINS.

"Ici l' art d'Arachné, rival de la peinture
"Reproduit les heros, les dieux et la nature."

IN the reigu of Francois Premier, that gay and voluptuous monarch, whose protection and encouragement of literature obtained for him amongst his contemporaries the title of *Le Père des Lettres;* and whose taste for the luxurious arts attracted round his court all the eminent artificers not only of France, but of other countries, there came to Paris two humble mechanics, who quitted their native town, Rheims, in the hope of bettering their fortunes in the French capital. At a period when splendor of costume was carried to such a point of extravagance amongst the *noblesse*, as to justify the remark of one of the old chroniclers that, "they carried their forests and domains upon their backs," the trade of our adventurers (that of *teinturier* or *dyer*) was one of the most lucrative of the occupations dependent upon the caprices of fashion.

Taking a small house in the Faubourg Saint Marcel, on the banks of the Bievre, Jean and Gilles Gobelin commenced their operations on a limited scale; and for some years they encountered all the difficulties and discouragements incident to a new career. By persevering industry, however, and the application of some of the then imperfectly understood principles of chemistry to their art, they at length surmounted the obstacles that opposed their progress; and the beauty and firmness of the colors which they produced attracted a large *clientèle* to their establishment. From this period Fortune, who when she is in a generous mood is no niggard of her favors, began to lavish them prodigally upon the two brothers. After monopolizing for years a large proportion of the trade of Paris, they began to invest the wealth that they had amassed in their dyeing business in the purchase of lands and houses. The brothers erected a monument to their own importance, one of those quaint, unsightly edifices which are still occasionally seen in the old quarter lying to the north of Notre Dame, and which was dignified by the *badauds* of Paris with the appropriate name of "Gobelin's Folly." This appellation was exchanged by an edict of the *Grande Monarque* for the high sounding title of the Royal Manufactory of the Gobelins.

The family of the founders of this establishment having in the next generation become too important to pursue any longer their calling, the building was sold to the Sieur Lelieu, a counsellor of the parliament, who let it to the brothers Cannaye. To the trade of dyers, these persons added the manufacture of tapestry, an article now coming into more general use. They were succeeded by a Dutchman, named Gluck, and Jean Liansen, or as he was more commonly called, Jans of Bruges, the latter of whom manufactured tapestry at the Gobelins for the first time on the *haute lisse*, or high loom.

Before we proceed to describe the process by which the marvellous results have been obtained which we see exemplified in the French Department of the Exhibition, it will be necessary to trace the progress of an art, which even in semi-barbarous ages was brought to no mean degree of excellence. The manufacture of tapestry is said to have been first introduced into Europe by the Asiatics who returned in the train of the Crnsaders. The first mention made of it in any existing document is that contained in an edict of the Châtelet in Paris, in 1295, which authorizes the establishment of a manufactory of the tapestry of the high loom, and gives permission to a Sieur Renaut to employ workmen and take apprentices. During the first century that followed its importation, the art made but little progress in France, for we find that Francis the First and Henry the Second, wishing to ornament their chateaux, gave orders for the execution in tapestry, at Brussels, of the battles and triumphs of Scipio, after the celebrated cartoons of Jules Romain.

Henry the Fourth gave a fresh impulse to the art, which had fallen somewhat into neglect, by an edict issued in January,1608, conceding certain privileges to the establishment formed in Paris by Messrs. Marc Comans and Francois Laplanche. In the Garde-Meuble of the crown are still preserved some pieces of tapestry executed at this establishment. Lonis XIII. continued to the children of these two manufacturers the privileges granted to them by his father. Some of the tableaux executed in this reign represent the life and miracles of Saint Crepin, and Saint Crepinien, and bear an inscription indicating that they were executed to the order of the shoemakers of the city of Paris, and were destined for the chapel of their corporation in the church of Notre Dame.

The community of *marchand-tapissiers* of Paris, which dates from a very remote period, had originally been divided into two distinct bodies; one of them being known under the title of the weavers of the high loom and fine-drawers, and the other under that of *courte-pointiers*, or weavers of counterpanes. The close resemblance of the occupations of these two branches of the trade giving rise to frequent differences between them, their union was ordered by the parliament in a decree, bearing date the 11th of November, 1621, and their new statutes were approved and confirmed by the letters patent of Louis XIII. in July, 1636.

Colbert having repaired and embellished the royal residences, and more especially the palaces of the Louvre and the Tuileries, next bethought him how he could furnish and decorate them in a style correspondiug with the magnificence of their architecture. With this view he called together all the most eminent artists and workmen who were scattered throughout the kingdom, and by splendid offers of pensions and privileges induced most of them to enter into his plans. He contemplated uniting these different branches of industry in one vast establishment, and placing it under the direction of some capable officer to be named by the king. In order to put the enterprise on a permanent footing, and to secure it against the contingencies of the future, he induced Louis XIV. to purchase the old hotel of the dyers Gobelin, in which a manufactory of tapestry was still installed. In November, 1667, the king accordingly issued an edict by which he created the *Manufacture Royale des Meubles de la Couronne.*

The very terms of this decree, the minute details into which it entered, the immunities and privileges which it granted to the workmen, such as the freedom of the city, the rights reserved for naturalization, and a special jurisdiction, attest the importance which, from its origin, Lonis attached to the manufactory of the

Gobelins. He confided to Le Brun, his first painter, and the artist who had decorated so many of the royal palaces, the direction of the new establishment, in which were soon employed several men who have left a reputation either in the arts, or in industrial pursuits. Of the number thus distinguished, we may mention the celebrated engraver, Sesbastian Le Clerc, for whom Colbert obtained a grant from the king in 1679, of apartments at the Gobelins with a pension of six hundred crowns. He was the author of the well-known engraving of the *Mai des Gobelins*, which was intended as a design for a permanent May-pole in the court-yard of the establishment, or rather as a trophy in honor of its royal founder, and of Charles Le Brun, the director of the works. The base of the pillar forms a pedestal of abont twenty-one feet in height. Above it is placed an oval medallion surrounded with palms, on which Virtue is seen trampling on Ignorance and Envy. Beneath is a figure of History inditing its records on the back of Time. We believe that this design was never carried into execution. Le Clerc, who espoused in 1673 one of the daughters of M. Vandenkerchoven, king's dyer to the establishment, died at the Gobelins in 1714, at the age of seventy-seven, after haviug lived there more than forty years.

In order to complete the *personnel* of the tapestry work-rooms, Colbert seduced by liberal offers several artists from the manufactory at Brussels, who had beeome famous for their copies of the cartoons of Raphael and Jules Romain. Amongst them was the elder Lefevre, who was placed at the head of the *ateliers*, with Jans of Bruges, who had been employed in the establishment from its commencement. To these skilful workmen was also confided the charge of forming the pupils.

To Le Brun, and to all the best painters of the day, orders were given by Colbert to compose pictures to serve as models for tapestry. Thus this manufacture, which had hitherto remained in the state of imperfection which had marked its first efforts, became at this epoch an art in which all the highest qualities of genius had room for display, and its productions were sought for throughout Europe, with as much eagerness as they are at present. In 1694, the prosperity of the establishment began to decline. The poverty, to which the war of Succession in Spain had reduced the Treasury, caused the king's orders to be suspended, and in the following year the number of *employés* was reduced by the dismissal of several of the workmen and apprentices. In a curions little work, now lying before us, entitled "A Journey to Paris in 1698," by Dr. Martin Lister, the writer gives a sad picture of the condition of this once flourishing establishment. He says:—

"The formerly so famous workhouse of the Gobelins is fallen miserably into decay, perhaps because the king, having finished all his palaces, has little more to do for them. Here I saw the making of marble tables, inlaid with all sorts of colored stones. Also the *ateliers* or workhouses of two of the famous sculptures: Juby, in which was a Laocoon copied in white marble admirably; also that other of Quoisivoix, in which was, amongst the rare pieces, Castor and Pollux, in white marble, exceedingly beautiful and large."

Under the reign of Louis XV. the establishment was temporarily closed; after a brief suspension of the works, however, it was again opened for the execution of some orders from the king for the decoration of the royal residences.

Up to this period, the tapestry had been manufactured by contract, or, in other words, at so much for the piece. The crown, however, lent its workshops and the looms, and advanced to the contractors the warp, the silk, and the wool. All these articles were noted down on the books of the storekeeper, and when the contractors delivered the tapestry he deducted the value of the materials. The manufactory of the Gobelins was not, as at present, exclusively monopolized by the crown; it enjoyed all the privileges of a private establishment, and carried on a trade in tapestry.

In 1791, the establishment was placed on a different footing. The workmen were paid by the year, and, with the exception of the manufacture of tapestry, all the other branches of decorative art organized by Colbert were broken up. In 1793 the operations of the establishment were again temporarily suspended in conseqnence of the enrolment of the workmen and the dismissal of the pupils. This crisis, however, lasted but a short time; after a brief interval the Jury of Arts reorganized the manufacture.

The suppression of piece work was attended with the most beneficial results. By leaving to the artist the freer disposal of his time, and permitting him to apply himself rather to the quality, than to the quantity of his productions, a marked improvement in the former was soon perceptible. These who had talent now took pains to cultivate it; and the study of the arts of design and painting contributed greatly to their progress. In short, the tapestry weaver became an artist, and under his practised fingers wool was made as powerful and lifelike a medium of expression as the pencil.

At present, the artist makes the warp himself, and traces and alters the design according to his judgment. He also chooses and employs his own colors, a part of the process which used to be kept quite distinct. The superintendence of each piece of tapestry is confided to one of the prineipal workmen; the general inspection to the *chef d'ateliers*, and the arrangement of the artistical details to an experienced painter.

The wools and silks are kept in skeins ready for use in the general store; each loom has however its own compartment, in which are deposited the materials chosen by the artist for the execution of his works.

Tapestry was formerly manufactured on both the high and the low looms; the former are now exclusively employed. The distinction in these names arises not from any difference in the work, but from the position of the looms. The low loom is placed horizontally, while the high loom stands erect. The *lisses* are small cords attached to each thread of the warp with a running knot, which forms a sort of ring or mesh; they serve to keep the warp open in order to enable the workmen to pass the needle through it, charged with the wool or silk.

The *basse-lisse* or low loom resembles the ordinary loom of the weaver. The design or picture which is to be copied is placed above the warp, where it is sustained by transverse cords. Two instruments suffice to work this loom—the comb and the needle. The artist places himself before the loom, separates with his finger the threads of the warp, in order to see the design, and, taking the needle charged with the color he wants to use, passes it between the threads, after raising or lowering them by means of the treddle upon which his feet rest; he then presses down the silk or wool he has placed by striking it with his comb. In the low loom, as well as the high, the artist can only see his tapestry from the side after he has finished each operation, unless he chooses to shift his loom, an inconvenience rarely thought of.

The *haute-lisse* or high loom is composed of four principal parts; two long madriers and a couple of large cylinders of wood placed transversely, the one above the madriers, and the other below them. When about a metre of the tapestry is finished, it is rolled on the lower cylinder, whilst the upper one furnishes the warps for the succeeding part. The warp is separated into two divisions by a heddle or cross stick; by this means half the threads are kept at an equal distance in advance of the other half. The threads of the latter, owing to the position of the artist, can be brought forward at will by means of the cords.

When the loom is prepared and the warp stretched, the first operation of the artist is to trace with white chalk on the threads of the latter the principal features of the picture which he has to copy. He then reproduces with a black pencil on transparent paper applied to the picture, the outlines which appear through it in white. He lays this tracing on the front surface of the warp, and secures it in its position by means of flat wands. He then reproduces the sketch on the warp by marking with a black crayon the part of the thread which corresponds with the dark parts of the tracing, so that in fact the design on the warp is only the reunion of the black outlines, each in its place. This process, which is effected part by part, in order that it may not get effaced, is indispensable to the proper execution of the work.

After these preliminary operations, the artist begins to copy with the worsted and silks which he has prepared, the model, which is placed behind him to his right, at the distance of about half a metre. In this position he has only to turn his head, whilst if it hung before him the picture would interfere with his light. There would be also this disadvantage in placing himself in front of the tapestry, that he would be obliged to cut the worsted or silk as soon as he had done with it, which would increase his labor considerably, and diminish the solidity of his work. By working on the wrong side, all the defects of the weft and the warp are drawn that way, and a smooth and delicate surface obtained on the face of the tapestry.

After passing his left hand through the space made between the threads of the warp by means of the heddle or cross stick, and making it wider by drawing towards him the quantity of threads that is necessary, the artist passes through them, from left to right, the worsted with which he is working, and when he has stretched it, he piles it with the point of the needle, then drawing back the needle in a contrary direction, he passes the worsted through the space left in their turn by the front threads of the warp when abandoned to themselves, whilst those at the back are brought forward. The backward and forward movement is called woofing. It requires two of these woofs to form the mesh. One of these weft threads is generally longer than the other.

It is owing to this ingenious combination of the woofs that the artist is enabled to pass with facility from dark to light colors, and to shade his picture with such nicety that it requires the most practised eye to discover where a color or a tint commences. It requires long practice, however, before he can find his way through such a multitude of reels and learn to design correctly with worsted on the movable threads. He has to imitate with this material the soft appearance of velvet, the glossy surface of silk, the firmness and hardness of metals, and the brilliancy and transparency of natural tints.

The principal tools or instruments used by the high loom weaver are the *broche* or needle, and the comb. The former is generally made of ash, and is from eighteen to twenty centimetres in length. Its head is round, and it terminates in a blunt point. The body is hollowed out in order to contain the worsted or silk.

The comb is made of ivory. It is made somewhat like an iron wedge for splitting wood. Its length is from fifteen to sixteen centimetres, its width at the top from five to six, and at the bottom from four to five. The bevelled end is

composed of from seventeen to eighteen teeth, separated from each other by narrow intervals, through which the threads of the warp pass. Its thickness at the base of the teeth is about 2 1-2 centimetres, and from thence it is bevelled off to a fine edge. The two ontside teeth are thicker than those of the interior, as in the case of the ordinary comb.

The time necessary for the execution of a piece of tapestry is of course proportionate to the dimensions and difficulties of the picture. It is impossible to calculate exactly the qnantity of work that an artist can execute; it is estimated on an average at about a square metre in the year. The value set npon a metre of this tapestry is about 3,000 francs.

There are six *ateliers* of tapestry in the Gobelins, and the number of workmen employed is about 120. The annual expenditure amounts to nearly 300,000 francs, and is charged on the civil list.

To this establishment was annexed in 1826, the celebrated manufactory of foot-carpets, called *la Savonnerie*, which was created a royal establishment in the beginning of the seventeenth century, by Marie de Medicis, in favor of Pierre Dupont, who invented the process for finishing the carpets, and who was placed at its head with the title of director. The *ateliers*, which were originally established in the chateau of the Louvre, were transferred in 1615 to a soap manufactory at Chaillot, from whence it derives its name of *la Savonnerie*. In this manufacture, as in tapestry, the artists themselves prepare all that is necessary for the execution of the work. The looms, with the exception that they are much larger, are identical with the high loom which we have described. The mounting and warping are also the same, with this difference, that when the warp is prepared, care is taken to arrange the threads so that one thread out of each row of ten, shall be of a different color from the rest. These tenth threads correspond with black dots made on the picture, placed at regular distances like the colored threads, and disposed so as to form squares which have the width of the ten threads. This serves as a substitute for the tracings required in tapestry weaving. The model thus divided in bands and placed before the workmen above the level of his head, is attached to the *lisses*, so that the dots in the picture correspond with the colored threads in the warp, and the artist sees at once what he has to execute.

After bringing towards him with his left hand the thread on which he is about to commence, he passes the worsted with his right behind the thread of the warp. He then draws from its side the succeeding thread, on which he makes a running knot which he ties firmly; but this knot on the thread would not make the pile, if before securing it he did not take care to insert the rounded extremity of the thread cutter (a steel instrument hooked at one end and terminating in a sharp blade at the other) into the wool, which thus forms itself into rings which he cuts in drawing them. The stitches made in the width of the carpet are united by a hemp thread passing from one end of the web to the other through the opening left by the heddle. The workman then recommences his range of stitches, and passes a fresh thread through the opening left between the back threads of the warp as they are drawn forward and the front threads when let go. By this means the stitches are as it were set in. The artist next combs the ends of the worsted and the hemp thread. When cut by the instrument above described, the rings leave ends of wool of an unequal length and consequently of an uneven appearance. These ends are cut with scissors with hooked blades, and thus is formed the velvet pile on the carpet. The worsted employed in the manufacture of carpets, no matter what may be its prevailing tint, is composed of five, six, and in fruits, of nine or ten different shades, combined so as to imitate exactly the model.

A special *atelier* is set apart for the purpose of uniting and fine drawing the different parts of large pieces of tapestry or carpeting, made separately on the loom, and for repairing with the needle parts that have been accidentally torn or eaten by moths.

The dyes of the Gobelins are as renowned as its tapestry. The beauty and delicate gradation of its colors justify this reputation. The dyeing department of the establishment is placed under the direction of M. Chevreul, a distinguished chemist, and a member of the Institute, who gives public lectures in the theatre of the establishment on the chemistry of dyeing. An erroneous notion prevails, that the beauty of the colors produced at the Gobelins is principally owing to the peculiar properties of the water of the Bievre. So far is this from being the fact that it is totally unfitted for the purpose, and the water of the Seine is that which is generally used. A rumor equally unfounded has obtained currency regarding the process by which the beautiful scarlet for which this establishment has been so long noted, is produced. Ignorance alone could have invented and credited the fable that a certain number of the *employés* are fed on roast meats and deluged with claret, in order to contribute to the virtues of the dye. The truth is, that the superiority of its colors is principally due to the skill and experience of the persons employed in this branch of the establishment.

There is a school of design in the building conducted by competent persons, in which the pupils draw from the antique and from living models. Several distinguished artists have issued from it, and amongst others we may mention M. Deyrolle, junior, to whom was confided the execution of the oil paintings intended to serve as models for the carpets designed by M. de Saint Ange, architect of the crown, under Louis Philippe.

The productions of the manufactory of the Gobelins, together with those of Beauvais and Sêvres, are exhibited every two years at the Louvre. The establishment itself, however, is open to the public every Wednesday and Saturday.

Amongst the most remarkable subjects which have been executed in this establishment, we may cite "The Battles of Alexander," "The Four Seasons," "The Four Elements," "The Royal Palaces," and a series of the principal events of the life of Louis XIV., from the time of his marriage to the conquest of Franche-Comté, after the designs of Le Brun. These admirable works are surpassed by the "Massacre of the Mamelukes," after the celebrated picture of Horace Vernet. This superb tableau was commenced under the directorship of M. Lavocat, and was completed in about six years (we believe in 1844). M. Rançon, an artist of great merit, executed all the most difficult parts of it, and was assisted in the remainder by MM. Bloquerre, Manigant, Hupé and Martin. It is kept in the exhibition room of the Gobelins as one of the greatest marvels of this beautiful art, in order that it may serve as an incentive to the ambition of the talented men who sustain so worthily the reputation of the establishment. It was forwarded to London in time for the opening of the Great Exhibition, and attracted universal admiration from the lifelike fidelity with which all the details of this thrilling scene are rendered.

Although the specimens that have been contributed to our own exhibition cannot be compared, either in size or in historical interest, with that which we have just noticed, they are nevertheless charming productions, their subjects being taken from the works of some of the best painters of the modern French school, such as Bouchet, Lancret, and Desporte, and the tableaux themselves executed by some of the most skilful artists of the Gobelins, and Beauvais. In the "Subject taken from the Chase and Still Life" for instance, nothing can excel the softness, the delicacy, and the brilliancy with which all the minute traits of both animal and vegetable life are rendered in these colored wools, in some instances, even surpassing the most elaborate efforts of the pencil. To our minds this is by far the best picture in the collection. The selection of the subject was a happy one, from the strong contrasts which it afforded, and the opportunity it thereby gave the artist of employing bold and effective coloring. In tapestry pictures, where the surface is not protected by varnish, as in the case of oil-paintings, and where the natural tendency to fade or collect dust must more or less affect the tints in the progress of time, it seems to us that subjects, in which the tones are subdued to that point which would be considered a beauty in oils, are not exactly those which are suited to the peculiarity of the material by which they are to be rendered. We may cite, as an illustration of this, the tableau entitled "The Wolf and the Lamb," which was executed in 1842 by M. Thiers after a picture by Desporte. Here, although the subject is unquestionably one of great merit, and has been done full justice to in the copy, the general effect is somewhat sombre. The truth is, that as transparency cannot be imparted to them by glazing and varnish, as in the case of oil-paintings, the predominance of these neutral tones ought to be avoided as much as possible in the choice of subjects for tapestry. In the beautiful tableau after Lancret, entitled "Autumn," we find as much to admire in the accessories, which have been grouped beneath it, as in the picture itself. The fruit and flowers are exquisitely rendered, and in fact the whole composition may be reckoned as one of the happiest efforts of that charming painter.

In "The Skaters," by Chevalier, nothing can exceed the grace, elegance, and spirituality of this beautiful little composition. The female figure is a perfect study in itself, and the general grouping is quaint and effective. The best tableau, however, from this manufactory, both as regards the spirited treatment of the incident that gives it its title, and the quiet beauty of the landscape which forms its background, is "The Combat of the Two Goats." "The Reading Lesson," from Bouchet, is also a *chef d'œuvre* in its way.

We subjoin a list of the tableaux, both from Beauvais and the Gobelins, that compose this little collection, together with the names of the artists, and the prices at which they are valued.

GOBELINS.

"Autumn," after Lancret; executed in 1849 by M. Maloisel, .	14,000	francs.
"The Wolf and the Lamb," after Desporte; executed in 1842 by M. Thiers; and "The Hound and Her Companion," also after Desporte; executed in 1842 by M. Prevotet, . . .	8,500	"
"Subject taken from the Chase and Still Life," after Desporte; executed by M. Hypolite Lucas, ...	20,000	"
Two seats and backs of chairs in carpet work; executed by MM. Renard and Gouthier, from designs by M. Godefroy, . .	2,500	"

BAUVAIS.

"Combat of the Two Goats," after Audrey, by Chevalier, .	4,000	"
"The Skaters," after Lancret, by Chevalier, ...	6,000	"
Landscape, after Desgoffes, by Auguste Melisse, . . .	8,000	"
Three leaves for a screen, after Audrey, by Chevalier, . .	20,000	"
"The Reading Lesson," after Bouchet, by Chevalier, . .	2,500	"

The ceramic art is largely illustrated in the Crystal Palace, both in the actual number and the variety of the specimens belonging to it. One of the largest contri-

butions is made by Messrs. Minton & Co., Stoke-upon-Trent, Staffordshire, England. To those who are acquainted with this branch of art-manufacture, it would be

superfluous to speak of the various excellence and beauty which belong to the productions of the Messrs. Minton, but as the Record may have other readers, we mention that this firm are in the very first rank of private or commercial manufacturers, and

yield only to the French national establishment at Sèvres, whose operations are con

ducted without regard to the cost or sale of its productions. A Council Medal, the

highest honor of the London Exhibition, was awarded to Messrs. Minton in 1851.

From their contributions to our own Crystal Palace we have selected and engraved the subjects which fill this and

the two adjoining pages. The first is a statuette in Parian, modelled after the design of Carrier, and repre-

sents THESEUS reining in his horse. The statuette adjoining is an AMAZON on horseback, and was designed by

Veuchere. It is followed by a pair of FRUIT DISHES of porcelain with colored and gilt decorations and figures in Parian. They belong to a dessert service. They are succeeded by the VINTAGERS, a group in Parian, and a

large FLOWER POT and stand, a reproduction of the famous Majolica ware. The design of this piece, and the bright and gay colors in which it is executed, are very attractive and beautiful.

The three statuettes which introduce this page, are all modelled after the designs of Carrier, and are deserv-

ing of much praise. The first is named PSYCHE; the middle one represents PROMETHEUS, and the third is PANDORA in the act of opening the fatal box.

The SUGAR DISH, and the piece opposite, form part of a very elegant dessert service, similar to that selected by the Queen in 1851 as a royal present.

The illustration on the left represents a FLEMISH JUG.

It is in white Parian, and bears figures in high relief.

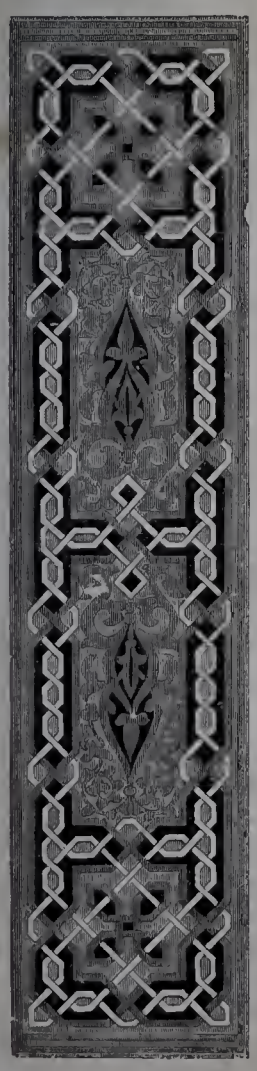
This misuse of material and style of decoration we can-

not regard with favor. The DIANA JUG on the other

side, is liable to the same objections, though to the last, in a less degree.

Our third page commences with the two

Parian figures in the style of Louis the Fifteenth. Their costumes are elegantly ornamented with gold, and the pedestals are set with excellent imitations of the turquoise.



The large Centre Piece belongs to the dessert service already mentioned. The basket and the pedestal are decorated with good taste, but our attention is chiefly

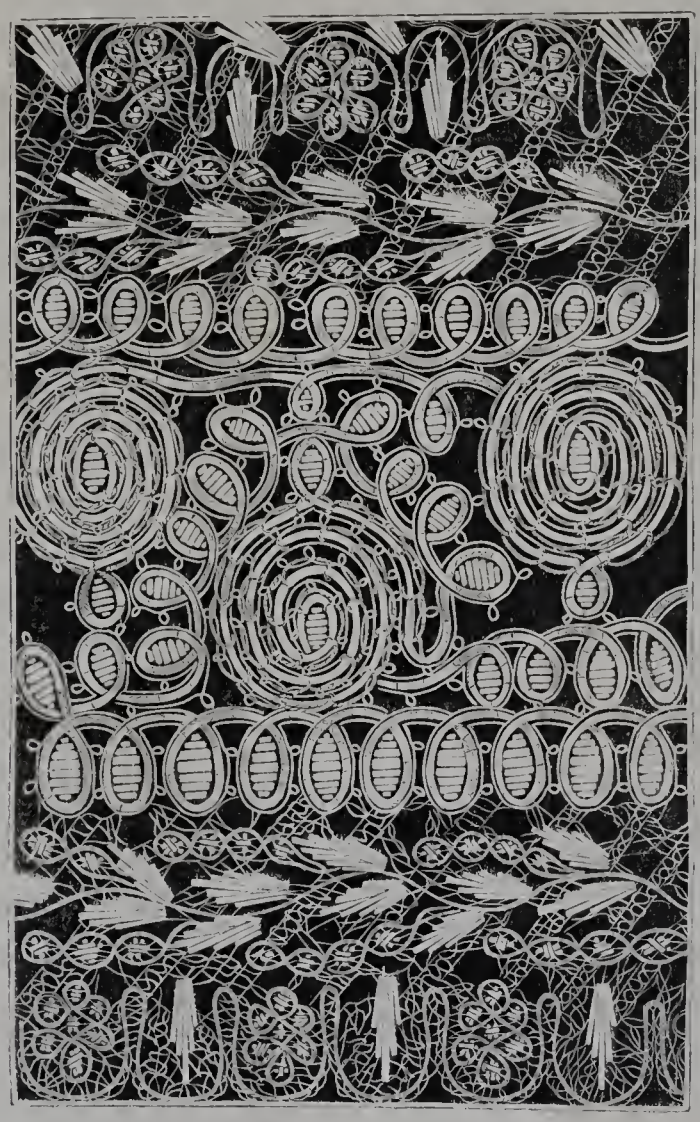
attracted to the graceful Parian figures which support the piece, and are every way beautiful and appropriate. They are allegorical, and

represent Love, Peace, and Abundance. To our way of thinking, this seems a more elegant table ornament than the more ambitious and far costlier centre pieces in silver, of which we have engraved many examples.

We have placed beneath two companion statuettes, modelled after Carrier. They represent an Irish Peasant Boy and Girl.

We conclude these illustrations with three Porcelain Tiles of different patterns, which are largely manufactnred by Messrs. Minton for architectural decorations, a use for which they are peculiarly suitable.

We engrave upon this page a specimen of the Bonnet Materials contributed by the inventor and manufacturer, George Long, Loudwater, Bucks, England. This



specimen is a woven openwork of horsehair and straw, and is equally light and beautiful.

The luxurious Arm Chair, of which we give an illustration, is exhibited by Mathew W. King & Son manufacturers, Broadway, New-York. It is upholstered with figured

satin, and very conveniently revolves upon a central axis.

The beautiful and rich carpet, one-half of which we have engraved, may be found

in the French Department. It is contributed by M. Sallandrouze de Lamornaix from his establishment, formerly the Royal Manufactory of Carpets at Aubusson.

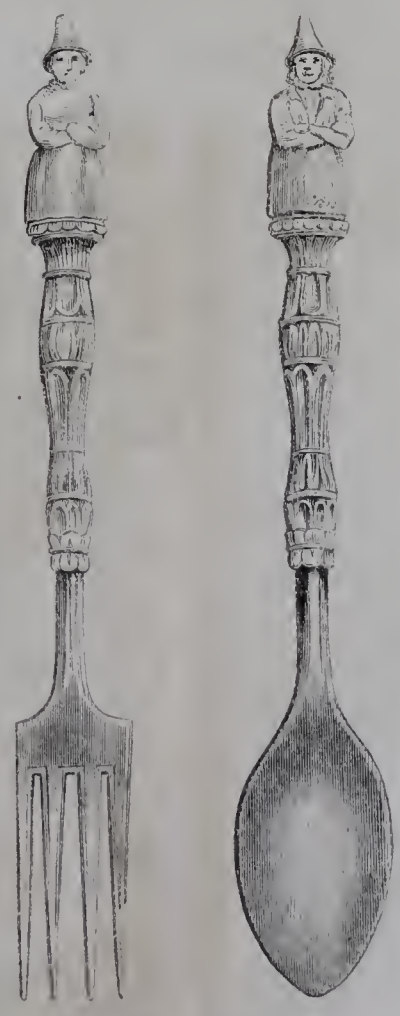
One of the best specimens of carving in ivory contained in the Exhibition, is that executed by Fra Carlo

Antonio, of Genoa, which we here engrave. The subject is the Descent from the Cross, and the artist exhibits

his skill in the varied expression of grief in those who have come to perform the last sad offices to the dead.

The two following engravings represent the top and front of a Cabinet, which is exhibited by the heirs of J. G. Lange, Oberamergau, Wurtemberg. This small cabinet is quite covered with laborious carving, which is

generally executed with spirit and fidelity. The top has in the centre a view of the castle of Hohenschwangau, and the front is similarly decorated with a characteristic scene of German life.



The remaining wood carvings on this page are also contributed by the heirs of Lange.

The silver CENTRE PIECE represents Arabs in the desert traeking travellers by

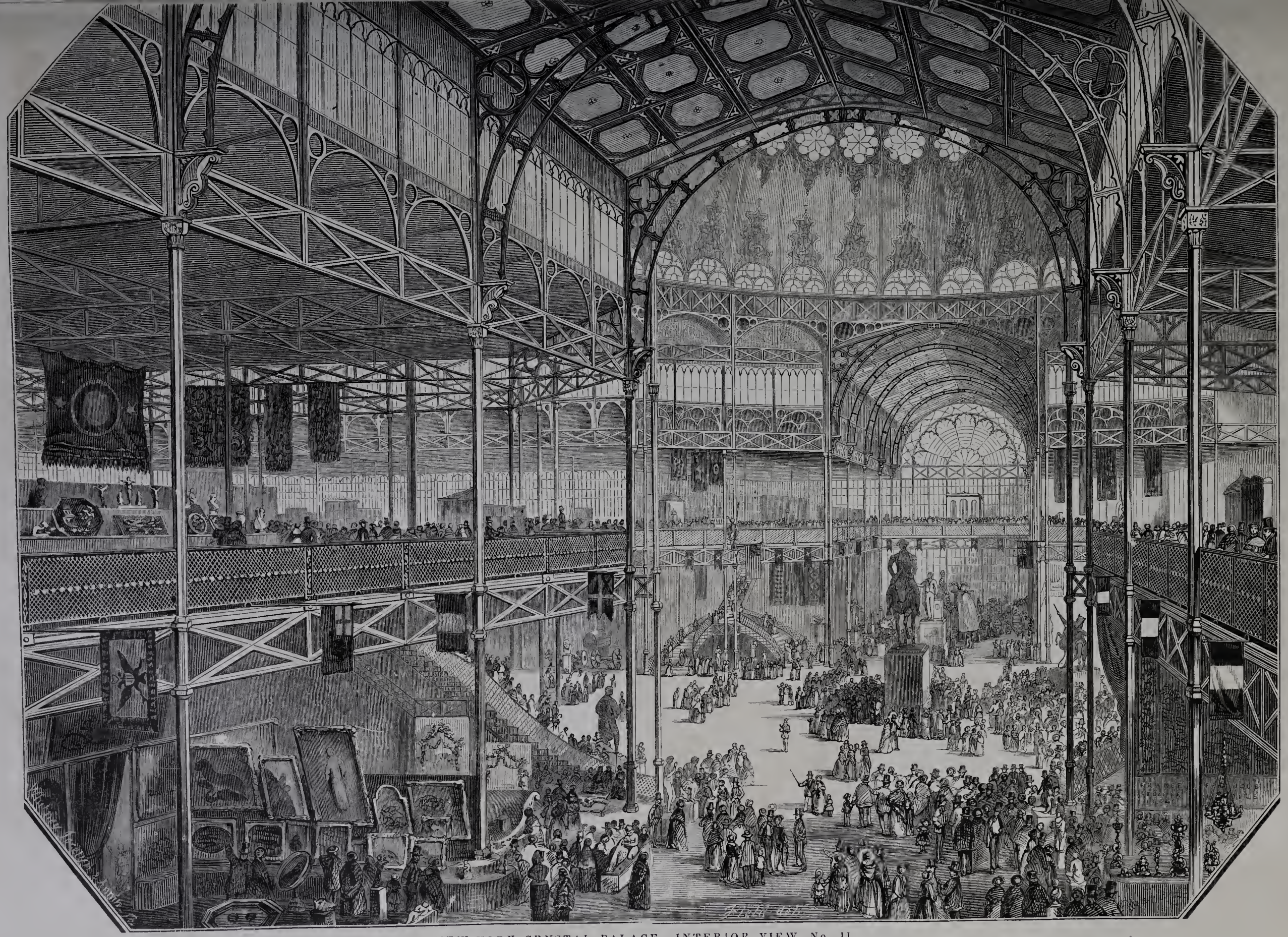
their foot-marks in the sand. The design of this characteristic piece was made by Edmund Cotteril, and it is exhibited by Messrs. GARRARD.

The BRACKET, elaborately and beautifully sculptured in wood, is exhibited by G. GALLIENA, Turin, Sardinia. It represents a wolf hunt.

A statuette in marble is contributed by EMILIO SANTARELLI, of Florence. The sculptor has aimed to present CUPID IN A MISCHIEVOUS MOOD.

Messrs. ROCHFORT & SKARREN, of New-York, exhibit a PANEL carved in rosewood.

The roses which form the ornament of this panel, are sculptured with much skill. The style of decoration which produces only fac similes of nature is not, however, that which displays the highest art.



NEW-YORK CRYSTAL PALACE.—INTERIOR VIEW, No II

THE FRESNEL LENS,
OR
DIA-CATOPTRIC ILLUMINATING APPARATUS FOR LIGHT-HOUSES.

IN connection with the beautiful specimen of art and workmanship catalogued under this title, it seems appropriate, and may be interesting to the student of the results of the Exhibition to have here some condensed memoranda upon Light-Houses; the modes of illuminating them; and the development which these essential aids to navigation have received in modern times. For in ancient times, commerce, chiefly carried on by land, stood less in need of them, and the mariner with his unfrequent freights clung closely to the shore. The light-houses therefore, of which industrious antiquarians believe they find a trace, could hardly have been more than beacon marks to assure the voyage by day, and by their very size, to loom large and dark by night; and even if lighted at all, they could not have surpassed the rank, if they at all equalled the efficiency, of our harbor lights of the present day. Such, for instance, was the Colossus of Rhodes, familiar to our school-days as a marvel; such the tower at Alexandria, whose locality (the island of Phra, or Pharaoh or Pharos), has been perpetuated to this day in the classic epithet for structures of more undoubted purpose and effect; that of Corunna, consecrated in Milesian tradition; and that of Capio, on or near the Andalusian Tartessus. Other structures of smaller size appear to have been placed at several prominent points on the coasts of Gaul and Britain, probably to guide the transport of Roman invaders and colonists; and Flamborough Head on the East Coast of England, seems to preserve in its name an allusion to a luminous beacon that stood upon it. But it was not until after the use of the compass and the improvements (or rather discoveries) in Nautical Astronomy of the 15th and 16th centuries, that lights in aid of navigation came to be systematically demanded, or formed part of the policy of even the most commercial people.

When this occurred, and as the towers, to answer their purpose best, had generally to be placed on points of land, salient or otherwise exposed to the winds and fury of the sea, cases often would arise where difficulties had to be encountered and outlay made, either of money or of skill on the part of the engineer, or of both. Some such cases, from the bold ingenuity exhibited or the happy narrative of the steps of the undertaking, have come to mark classical epochs in the history of Light-Houses.

Among these may be mentioned (first in point of date, and as having been kept up sedulously ever since, abreast or ahead of all its class, so that a detailed account of it would be also a tolerable index of the improvements in the architecture and illumination of lights), the Tower of Cordouan, at the mouth of the Gironde on the Bay of Biscay. Begun in 1584, the troubles and tumults of the League of France, and the often anxious counsels of Henry IV., prevented its completion until the death of that monarch in 1610. More than fifty years afterwards, in the magnificent period of Louis XIV., additions were made to it, and the structure partly rebuilt. Its cost would be equivalent to nearly or quite a half a million of our money. Its historian is Bélidor.

Great Britain has always contributed most largely to these provisions of commerce; and the Eddystone Light, remarkable for its vicissitudes; that of the Bell Rock, whose seat is hardly ever dry even for a few hours; and that of Skerryvore, the latest triumph of the art, are places of pilgrimage for engineers who wish to note how apparent impossibilities may be overcome.

The first of these, built on a rock in the English Channel, opposite the mouth of Plymouth Sound, and some ten miles from land, goes back originally as far as 1698, when a light was shown from a wooden tower. But the water which rages there at times, and can submerge an object sixty feet in height, soon rendered an enlargement indispensable, and, after that was made, a fresh repair. It was upon a last occasion of this sort, deep in November, 1703, that the Engineer Winstanley, and all hands employed, and all visible preceding prints of their labor, were swept away at once. Five years afterwards it was replaced, still of wood, and so continued until 1755, when a new agent, fire, destroyed afresh what the wind and waves for nearly half a century had failed to move. Immediately after, and now almost a hundred years ago, the real Eddystone of mason work, artificially and curiously designed and laid, and which reciprocally immortalizes, and is immortalized by the name of Smeaton, began to be built, and was shortly after finished. It is to be hoped that art has now triumphed over nature, and that care will exclude accident, so that in a distant future the inquirer into the history of Light-Houses, more fortunate than ourselves, may have an existing and undoubted specimen of the art as it was with us.

The Bell Rock, a lonely and never long uncovered reef, some twelve or fifteen miles from land, opposite the firth of Tay on the East coast of Scotland, testifies in its name to the honor of the monks of Aberborthwick, whose pious charity devised a floating bell tolled by the moving waves, and rung with more appalling energy the higher rose the storm, to warn the mariner of what he was approaching. But with the decay of the Abbey went also the bell. Twice afterwards private beneficence provided there a wooden beacon that speedily followed the bell; but about the beginning of this century (in 1811) after nearly four years dangerous labor, Robert Stevenson (of a family whose members have to be designated by their Christian names, since it has furnished so many names of eminence), under the authority of the Commissioners of Northern Lights, completed the present stone structure. In this the old tradition is revivified; and the song of the Bell, now moved by the revolving machinery of the lamps, is still heard,—a warning adjunct in foggy weather.

Skerryvore, the last that need be mentioned, is on a reef of rocks lying on the western coast of Scotland, and among the Isles celebrated in one of Sir Walter Scott's metrical romances, the materials for which, in fact, he gathered during a reconnaissance in 1814, when he accompanied the Northern Light-House Board and their Engineer, Alan Stevenson, for the object, among others, of examining this very site. So difficult, however, appeared the work, and so faint the chance, that twenty years had passed by before the question of placing a light there was seriously taken into consideration. Then, in 1834 a minute survey was begun, and in 1838, the work of building was commenced, and the tower lit up in 1844. This Light-House is remarkable not only for its dangerous position, and for its size, in which it more than doubles that on the Bell Rock, and nearly quintuples the one on the Eddystone, but also for the extreme theoretical and practical skill in both its architectural and optical relations developed there by the distinguished Engineer, Alan Stevenson, who may justly be regarded as among the very first authorities, living or dead, on the subject of Light-Houses.

In building a Light-House, these two relations, optical and architectural, or its brilliancy and its permanence, are the chief things to be considered. In respect to the latter, both theory and practice seem to agree in showing that it is to be obtained by the *weight* or *inertia* of the insisting building, with an external shape, of course, the best calculated for presenting the least resistance to the waves, and for allowing them the soonest to expend themselves, rather than by any complicated mechanical framing, which, in some other works, is the most approved mode of obtaining the required strength of resistance. Hence stone, which is twice and a half as heavy as water, has been found of far more successful application than wood, which last material, indeed, has become only traditional in dangerously exposed situations. Lately, a substitute has been proposed of broken stone concreted with crude iron, which claims also this advantage, of being moulded in any form, and especially with the Smeaton dove-tails and joggles, that render the various parts of the building incapable of being moved by any force short of what transcends the tensile strength or cohesion of the material. Wrought iron has also been proposed and used; but in general with a sacrifice of the idea of inertia to that of a mechanical fastening to the rock foundation of a tripod or multiple-legged frame, bearing the necessary lantern and chambers above and beyond the reach of the sea. Cast iron, whose weight is nearly triple that of stone, and seven times that of water, would, in cases where the risk is great, and the expense at all considerable, be most likely the best resort both for economy and permanence. The use of this material in plates, however, as has been proposed, does not appear to be the most eligible; it should rather be cast in solid rings, or in segments to be bolted together, and thus form the entire periphery of the tower.

Suggestions of this kind, however, although they relate to what must be admitted as the most important point in Light-Houses, namely the maintenance of the building, and so its very existence as a Light, do not constitute the most attractive speciality of the subject. This is rather the optical part, and what concerns the mode of illumination and the light itself.

Down to nearly the beginning of the present century, the only illumination known, was from the combustion of wood or coal in suitable grates or chauffers. Next to the glare of this open fire, which was as expensive and troublesome as it was variable and inefficient, came the light from tallow candles. For forty years after so much thought and labor had been expended in erecting the Eddystone, the light it gave was from no other source than these. Other lights elsewhere, it is true, used the flame of an oil lamp at an earlier date, but the wicks of the lamps were all solid, and the combustion of the oil, or rather of the inflammable gas from it, very imperfect, as is seen in the quantity of smoke evolved. And even when an improvement was made by flattening and thinning the wick, the supply of atmospheric air essential to combustion, was only external, and a considerable quantity of carbonaceous matter on the inside necessarily went off without contact of air, and therefore unconsumed.

It was reserved for Argand, about the year 1784, to invent the well-known lamp with a circular hollow wick and burner, that still bears his name. In this the wick is thin, and the air supplied on both sides, without and within. The addition of the glass chimney to the burner makes the combustion nearly perfect; and to this day, although there have been some slight modifications of arrangement, nothing has been devised to supersede his original idea. The efficiency of the double current thus furnished, any one may easily test, who has

an Argand burner, by closing the apertures over the drip-pan, through which the interior current of air is supplied. The lamp instantly smokes terribly, while on opening the apertures again, the smoke ceases, and the flame falls and becomes white.

The oil used for these lamps was at first spermaceti oil, or olive oil. Latterly, in England, but especially in France, oil of Colza, obtained from a species of wild cabbage and similar to what is known here as rape-seed oil, has been extensively introduced, and is preferred on account of giving a more intense brilliancy, steadier flame, and less charring of the wick, as well as on account of its greater cheapness in the market than any other oil in use.

Other materials for illumination have been, it is true, proposed at various times in the last twenty-five years, but none that appear, on a consideration of all the circumstances, superior to oil. Thus the use of carburetted hydrogen gas distilled from coal, rosin, or oil, such as is used for street-lighting, has been suggested; but the greater risk of irregularity in the manufacture and supply, as well as the inconvenience of feeding with it those lights that are intended to revolve (at least on the reflecting system), have been judged to render it inexpedient. The voltaic light of Mr. Gardner, produced by a current of electricity between two nicely adjusted charcoal points; the Drummond light, arising from the ignition of lime in the flame of an oxy-hydrogen blow-pipe; and the Bude light of Mr. Gurney, in which oxygen (instead of the dilution of that gas in atmospheric air), is furnished to support the combustion of oil, all afford a flame of great brilliancy and intensity, but are so comparatively complicated and uncertain as to be of disadvantageous, or at least doubtful application, in a system whose purpose requires every arrangement to be simple, uniform, and unfailing.

But whatever may be the material for producing the flame, it is manifest without any particular investigation of the laws of light, that of a mere naked flame, a large part (probably 7-8 of the whole), will be diffused without serving any useful purpose. This useful purpose in the case of great sea-lights, is, to be visible at as great a distance as possible; hence, with these, the rays or beams of light require to be nearly horizontal. In smaller lights, such as for harbors, channels, &c., the purpose is, to be visible close at hand; for which a greater divergence or throwing down of the beams upon the surface of the water is requisite. In either case it is obvious that the whole of the upper part of the flame above its centre, from which the beams are virtually radiated, is useless, for it strikes above its horizon where it could not possibly be seen, unless some auxiliary contrivance be adopted for catching, as it were, those stray rays, and diverting them in a proper direction.

As it happens in many instances that only a part of the horizon is seaward, and therefore needs the illumination, the earliest used of such auxiliaries would be a flat reflecting surface, like the plate of brass which, so late as the beginning of this century, was to be seen on the landward side of the flame at some of the English Light-Houses. But a flat surface would soon be found inefficient, and, in point of fact, would not collect more than 5 or 6 per cent. of the otherwise lost light. A spherical one would be better, and we may suppose followed next in improvement, yet leaving much to be desired. Geometers had long known the properties of another curved surface, which they term paraboloidal, in the capacity which it has of transmitting in a direction parallel to its axis, all beams that radiate on it from a particular point called its focus; but the mechanicians were either not properly invoked, or else shrunk from the practical difficulties of executing a reasonably correct surface of the form required. Small panes or facets of looking-glass were tried, set in paraboloidal moulds of wood or plaster, but at last, stimulated by the improvement in the light of Argand's lamp, the genius of Borda, about 1784, triumphed over the obstacles, and caused the erection in the Cordouan Tower of really paraboloidal metallic reflectors.

Since then, the immense advantage of this method has caused it to be adopted every where under various modifications, and as every system, to be known must have a name, this from the Greek word expressive of its most remarkable feature, is designated as the Catoptric system.

It is clear, nevertheless, from the form of this curved surface (which is most like the larger end of an egg-shell broken transversely about one-third of its length from that end, and with a luminous point placed about two-thirds of the depth inside), that the efficiency of the light within is laterally very much restricted by the sides of the reflector, beyond which the flame would be of course masked. In point of fact, a single lamp and reflector is only brilliant over about 4 per cent., or the $\frac{1}{25}$th of the horizon, to extend which arc of efficiency, it is of course necessary to place the lamps and reflectors themselves in an arc, or where the whole horizon requires to be illuminated (as in great sea-lights situated off the mouths of estuaries) in the circumference of a circle. In order to obtain the requisite quantity of light, lamps so arranged are placed tier above tier, until found sufficient.

Another resort was had by Borda, which, as affecting another point of great importance in the distinctive character of lights, is of immense interest, while it answered also the immediate aim of being visible over the whole horizon—in making the frame that carried the lights revolve. In this arrangement, the lamps and reflectors are set, instead of in a circle, tier above tier on the sides of a square or polygon; and, as they turn on a central vertical shaft, each set of lamps successively throws its light over every point of the horizon. As the rate of revolution is quite rapid, the intervals of greatest brilliancy at any given point are very short, not exceeding a few minutes.

In this way, both because the impression on the eye of the observer from the first beam, for instance, is augmented by that from the quickly following second beam, and because the lamps can be more conveniently adjusted on a plane than on a curved surface, revolving lights are, with the same number of lamps, burning a uniform quantity of oil, virtually more luminous than if the frame were fixed. Besides, by altering the rate of revolution, the intervals between the greatest and least brilliancy (the first occurring when the observer is directly opposite the lamp-bearing face, and the last when the dark angle of the frame is in line with him), may be altered too, so as to give within certain limits quite a marked and distinctive character to the light in question.

Various other modes (some of them of extreme ingenuity, and among these that of Bordier Marcet, the pupil and successor of Argand) have been proposed for illuminating an entire horizon at once, by cutting away the closed end of a reflector, and thus retroverting the rays. But none of these appear to have commanded an undoubted preference, and therefore need not be spoken of here, where the object is more to indicate the actual, than to speculate on the possible.

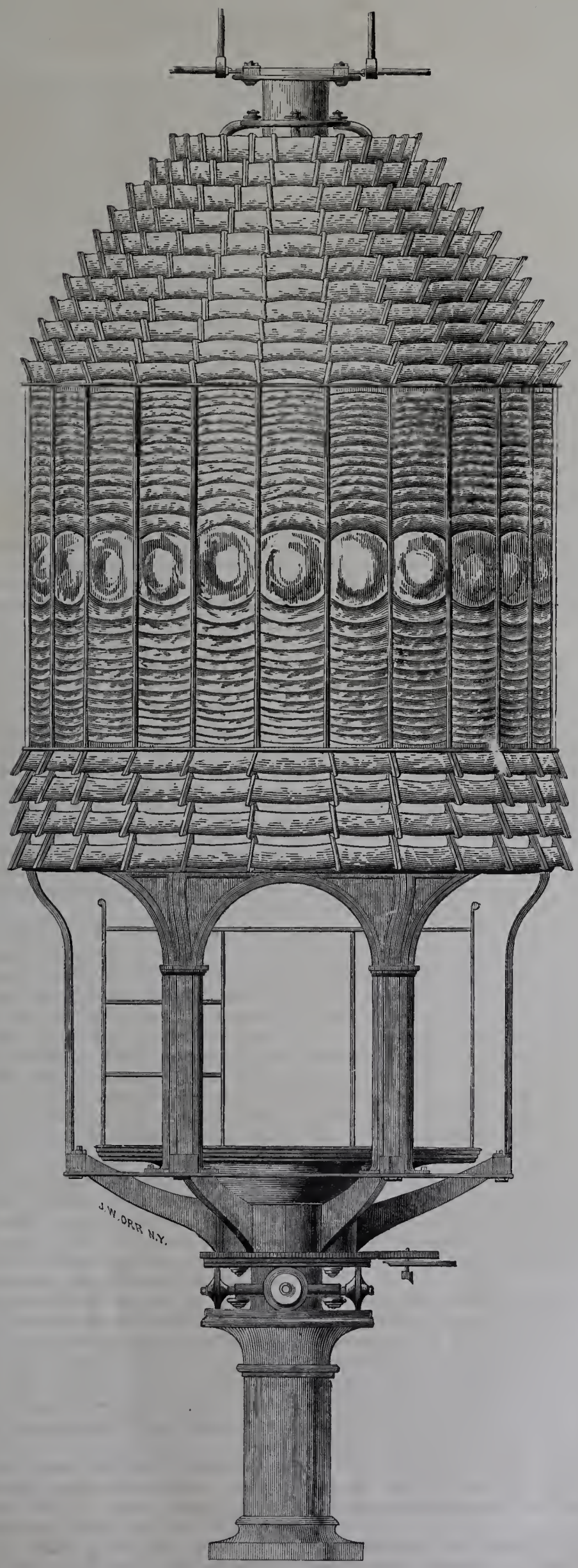
Perhaps one of the most efficient obstacles to the success of these contrivances, which with all their geometrical profundity are rather complicated and fatiguing to be considered, has been in the adoption of another system, proceeding upon an opposite principle; and which, instead of reflecting the rays by a polished surface, causes them to pass through glass, and to be, as it is called, refracted. In the nomenclature of this, as of the other system, the classic language of Greece has been resorted to, and from the old word in that country signifying *to be visible through*, it is termed the Dioptric System. And as in the progressive improvement towards economy of light, reflections of the wandering rays were produced by special contrivances, it has also seemed proper to designate it as a compound system by the title Cata-dioptric or Dia-catoptric. This alternative epithet is, to be sure, used more according to the taste of the person employing it, than according to any established rule.

This system, however entitled, is due to Augustin Fresnel, a Frenchman by birth, but a cosmopolite by genius, whose name will ever be recorded among the highest of those whose researches in pure science have been applied by themselves to the vast practical benefit of mankind. And it was with the severe logic grown familiar to him in such researches, that he was enabled to sweep aside from the practical problem the vague crudities of those who had preceded him, and to go at once, unerringly and unfailingly to his well-defined and beneficent aim.

The principle of this dioptric system is easily intelligible to any one who has ever amused himself with a burning-glass, or sun-glass, or magnifier. In that, the rays from the sun, which from the great distance traversed may be assumed as being parallel, are bent from their rectilineal course both on entering and on leaving the glass, so as to be converged to a point or focus, which is brilliant and heating in proportion to the size of the glass, and therefore the number of parallel rays falling on it. Now if we consider the condition reversed and the luminous point or light at the focus to be pre-existing, it is evident that the rays diverging from it towards the glass, will be bent in passing through, and must come out parallel on the other side. This geometers and opticians knew, and they also knew, before Fresnel, how to calculate the amount of bending or refraction which must take place in a piece of glass of a given convexity. So, a hundred years ago, lenses were actually applied in several light-houses in England and Ireland, but the practical conditions conformed so badly to the theoretical, that the implements became consumers instead of economizers of light. The principal difficulty seems to have arisen from the great thickness at the centre given to a uniform lens cut from one piece. Buffon conceived the idea of cutting away a great part of this superfluous thickness, and of cutting the lens in concentric echelons. The keenness of this conception was more than neutralized by the mechanical difficulties of the execution, and except the two glasses of Rochon and Cookson, no one has been bold enough to try the experiment again.

The idea of Buffon seems to have been that the lens, to work satisfactorily, must be of one homogeneous and continuous piece; and this seems to have possessed him, although he saw so clearly that breaking up the curved continuity of surface would not embarrass the result, and was therefore just upon the right track.

Condorcet, who, in his capacity of Secretary to the French Academy of Sciences, pronounced the eloge of his illustrious fellow-member, and who therefore had studied connectedly and dispassionately the progress of discovery in Science and Art, was not thus pre-occupied, and at once seized upon and happily expressed the idea of building up a lens in separate pieces. But neither he nor Brewster, who, in 1811, spoke judiciously (as he always does) in relation to the same suggestion, followed it up; and it was reserved for Fresnel, in 1822, both to describe the theoretical principles, and to give the practical formulæ for what he termed *annular* lenses. In this we hardly know which most to admire—



THE FRESNEL LENS—ELEVATION.

his mathematical logic or his mechanical intuition; the accuracy with which he defined the abstraction, or the comprehensive self-possession with which he knew how, in certain particulars, to concede something of the rigidity of that abstraction to the incomplete resources of the mechanician. Yet he was fortunate too in his mechanical assistant; and the name of *Soleil* still lives in significant connection with an apparatus capable of making an oil lamp of man's construction, to rival the same situations, and indeed, replace the *Sun*.

A similar good fortune seems to have attended his design ever since, and the several improvements of Léonor Fresnel, Alan Stevenson, and Reynaud, have been skilfully met and carried out by Soleil, Jr., Lepaute, and Letourneau. A considerable part of the success is owing to the superiority of the manufacture of the glass, in which the French (thanks to the judicious and liberal aid afforded by the government) excel all other nations. The superiority of the French glass, in fact, has rendered the Paris workshops tho only resort for Light-House lenses, and until an equally good material can be produced elsewhere, any competition is both needless and hopeless.

The main improvements just now mentioned, consist in dispensing to a considerable degree with metallic framing for the separate elements of the lens, and above all, in making the horizontal section of the lens annular instead of polygonal, as it was first built. But these particulars are more artistical than normal, and the most approved form, which the lens that these notes are intended to illustrate may be taken to exhibit, is yet substantially the apparatus of Fresnel.

As constructed, then, the lens may be described as consisting in the middle part of a cylinder of glass, composed of a plano-convex hoop in the centre, and above and below of a number of hoops having each a triangular section, which, when united, present the appearance of a number of right and inverted hood-mouldings. All these hoops are in segments connected together, and finally secured by an upper and lower rib and staves of gun-metal. Above this cylinder is a truncated cone of triangular hoops of glass as before, compacted vertically by a staircase bracing of metal. This cone takes the place, and more, of tho plane mirrors that were at first applied to catch and collect, and suitably distribute the rays that would otherwise be lost upwards from the flame. And in like manner similar hoops are arranged below in an inverted sense, to serve the purpose of the earlier small paraboloidal mirrors that received the rays, all wasted else, below.

The operation of the lens when the light is to be fixed, is readily intelligible. The lamp being lit, diverging rays striking any part of the central plano-convex lens, are bent in passing through it, and come out in a direction parallel with the horizon. The same happens with rays of greater angular elevation or depression which transcend the plano-convex rib, and fall upon any of the hoops; they are bent in their passage and transmitted horizontally like the former. Those rays, however, which reach the conoidal hoops either above or below the cylinder, undergo a more complex action; the alternating refraction and reflection in which justify the epithet before given of cata-dioptric. Taking one of the hoops of the upper conoid, for example, a ray from the lamp striking upon the convex surface of one of the sides adjacent to the obtuse angle of the triangular section, is refracted upwards so as to strike within a particular angle (that of *total reflection*, as it is called), the curved surface of the longer side of the hoop's section. If it struck this last surface at some other arbitrary angle, instead of being reflected, it would pass through the surface, be bent in passing and thrown out vertically upwards. But the proper angle having been attained in the section of the hoop, and its position in respect to the focus (and thus the limits of possible rays), tho aforesaid ray does not pass at all through the surface, but is thence reflected downwards, to the remaining surface of the hoop, where it has to endure one more bending that allows it then to escape horizontally and parallel with all the rest. With the hoops below the cylinder, the action on tho ray is just tho same, only the path is inverted; and, in both cases, the divergent rays from the lamp go round a corner, as it were, in order to fall into the line of proper horizontal direction.

When the apparatus is a revolving one, the behavior of the rays is the same; their optical effect and appearance, however, is different. Instead of presenting a steady light of nearly equal luminousness to every are of the horizon, they show successive flashes or blazes of light, succeeding one another at intervals, which are regulated by the rotation of the apparatus, by the sectional form of the hoops, in a measure, and their angular position with respect to the focus. Variations in this particular may be arranged to alter, within certain limits, the respective durations of the flashes and the intervening obscurity, and to make at given distances even positive eclipses of light. These flashes and eclipses are, in the particular lens here catalogued, uniform for the whole vertical height of the apparatus; a property not so fully enjoyed by any other one before, and which therefore entitles it, and its duplicate, now being made for the Cordouan Tower, to the epithet, among others, of *holypsal*.

Each one of the horizontal elements or hoops, in number above forty, requires its own special calculation for its particular form on all its sides, varying according to its distance from, and angular relation to, the focus and the size of the lamp there. The section of these hoops has been called just now triangular; but the triangle is in fact spherical: the reflecting surfaces and the inner refracting ones towards the lamp being convex, and the outer refracting surfaces towards the horizon being concave, with radii of curvature varying for each.

One who looks at the result only in the lens as built, can form but little idea of the extensive arithmetical apparatus preliminary to determining what the elements shall be; or of the vast demands for patient and intelligent labor in forcing a refractory, yet fragile material, like glass, to adapt itself to these determinations. And after all this has been done, it is no small task to arrange the elements conformably together; or even to test when entirely finished the accuracy of their adjustment.

The lamp of the apparatus has already been several times referred to, and is one of the most important parts of the arrangement. In fact, upon it depends, in the first place, the whole efficiency of the apparatus, and as it is single and stands alone, upon it falls, too, a great part of the responsibility. As devised by Fresnel, it consists, for the first order of lights, of an Argand burner of four concentric wicks, each, of course, having its appropriate currents of air outside and in, and its proper rack for regulating its height, which is in general ¼ inch. This assemblage is supplied with oil by a pump, as in the well-known Carcel or Mechanical lamp. Of course, no contrivance like a fountain lamp, such as is proper for reflectors, could be applied here without cutting off a portion of the light; and besides, the pump answers the purpose, even better, of supplying uniformly the excessive quantity, (about three times the actual consumption), that is requisite to prevent the partial combustion and coaling of the wicks themselves. Such is the uniformity attained in this part of the apparatus, that but three cases are reported as having occurred in the Scottish light-house establishment, during a period of nearly ten years, calling for a replacement of the lamp, by tho sparo one, during the hours of burning; and such the efficiency, that in the same establishment, lamps are known to burn with colza oil for seventeen hours, without any necessity for trimming the wicks.

The quantity supplied by the pumps (worked by a weight and a train of clock work) is per hour $6\frac{5}{8}$ lbs., or about $\frac{6}{7}$ of a gallon of oil; of which, one-fourth is burned, and the rest flows over the wick and is caught in a dripper below, to be strained and used over again. The volume of flame maintained by this supply is nearly a cylinder about $4\frac{1}{2}$ inches in diameter and about 4 inches in height.

The difference between a luminous mass so large and the mathematical point of light, infinitely small, which lies at the bottom of the theoretical conceptions of the subject, might at first sight appear likely to cause uncertainty and error in the arithmetical determinations. But this is much more than compensated by the advantageous physical effect which results. In fact, although the uniform distribution of rays of equal intensity over every part of the horizon, belongs only to such a mathematical point as has been mentioned, aided by forms deduced from rigorous geometrical laws, yet this is attainable nearly enough otherwise; while the overlapping, as it were, of the reflected and refracted beams, which arises from a focal flame of large volume, is essential to the prolongation of the flashes to a degree that will answer the purpose of the mariner. The duration of these flashes belongs to the divergence, owing to the great volume of the flame.

Such, then, is the Fresnel lens of the present Exhibition, which, though it does not hold tho costly charms of the Koh-i-noor, yet offers in this a work of art far more valuable than any diamond that ever gleamed in Golconda: for it concerns, not human pride and ornament, but human life and hopes and fears of almost countless hearts dependent on that life. It must not be supposed from this apparently exaggerated eulogium of tho Lens-Light, that the catoptric system is depreciated. There are circumstances, on the contrary, in which the appliance of reflector-lights upon the old system, would bo undoubtedly judicious and economical. Indeed, no system could be otherwise than partial in successful result, which does not combine (as the Fresnel lens, in its measure does) the phenomena of both refraction and reflection. It is upon this conclusion that the improvement of Alan Stevenson rests, in placing a spherical mirror behind a Fresnel lens, in locations where only part of the horizon is required to be illuminated, to catch and return the landward rays that would otherwise be useless. And with this accords too, the valuable suggestion of *holophotal* arrangements by another Stevenson—Thomas, the last who will bo named here, which consists of a curved reflecting surface, or surfaces that throw forward all the posterior rays, and of a refracting series which does the same for the anterior rays, which in the common catoptric system are left to go off as ordinary divergent rays, and are therefore useless for nautical purposes.

But leaving those improvements which certain circumstances would sometimes render very appropriate and desirable, and leaving also the exceptional cases in which the ordinary catoptric system would be all-sufficient, and the most economical, the relative merits of this last, and of the lenticular arrangement for general purposes, and as a normal feature in a national establishment, have been long since ascertained, by photometric and financial comparison, to be largely in favor of tho lens. It is true, that a reflector from its nature receives and transmits about ten per cent. more of tho actual luminous cylinder than the lens arrangement can do; but this greater quantity is distributed over a larger arc, and therefore so diluted, as it were, that tho space-penetrating power, or range of equal volume of flame (other things being equal), is less. Also, the

equal distribution of light over different arcs of the horizon at equal distances, is much less nearly approached in reflecting than in a catadioptric arrangement. Finally and conclusively: in an administrative point of view, the quantity of light obtainable in the combustion of equal quantities of oil in the same time, is four times greater in the lenticular than in the reflector system.

And this verdict of experts is every year more and more being accepted and conformed to in the great National Light-House Establishments of the world. Since 1822, when the Cordouan Tower first received a Fresnel light, these lenses, of different sizes to suit circumstances, have become universal along the coast of France. Holland was the next government to follow the example of France; and, after some efforts to manufacture the apparatus for its own national use, abandoned the attempt, and gladly reverted to the French workshops. The other maritime nations also throng those shops; so that for some years it has been difficult to have the various orders filled as promptly as they are wanted. Thus in the five years, from 1846 to 1851, to go no lower than the 3d order lens, which has an inside diameter of nearly forty inches, there have been constructed of those great sea lights upwards of one hundred and twenty. In these every maritime power has had a share. Russia only, at St. Petersburg, manufactures for herself under the guidance of the younger Soleil, by which the number may be increased to about one hundred and forty, or more than one half, it is supposed, of all the stations where lights of the powers included would be considered necessary. The whole number of lens lights in the world was estimated in 1851, apparently upon authentic statistics, at three hundred and sixty-eight; a number transcending all the lights, stationary and floating, existing upon the immense extent of coast of the United States.

In this country, where the Light-House Establishment had been placed under an accounting instead of executive control, not much activity has been, until lately, displayed. The discussions in Europe since 1830, however, did not fail of attracting attention here; and at length, in 1838, an appropriation was made by Congress for the purchase of two lenses from Paris. These, one of the first and the other of the second order of Fresnel, were, after some time, placed at the Highlands of Navesink, near the entrance of New-York Bay, where they are still, and might seem to have been long enough, in spite of imperfections in their management, to have stimulated a more general acceptance of the system.

Some time after, in 1845, the then Secretary of the Treasury, Mr. Walker, took the subject up with his characteristic ability, and obtaining the detail of two officers of the Navy, Messrs. Jenkins and Bache, despatched them to Europe for the purpose of examining and reporting on the Light-House systems there. This duty they performed to the entire satisfaction of the Department.

But at that period, several causes, and principally the absorption of the Government in the military operations that were then being carried on, prevented the interest that was felt in the subject from being effectively exercised; and it was only in 1851 that Congress authorized the creation of a provisional Board, to examine into and report upon the condition of the Light-House Establishment of the United States, upon a plan somewhat in accordance with the recommendations of the Hon. Secretary of the Treasury in 1846.

Early in the following year (1852), this Board presented a voluminous report of inquiries, considerations, and recommendations. The plan of re-organization submitted by it was approved by the then Secretary of the Treasury, Mr. Corwin, and, mainly by the lucid explanations of the Hon. Alexander Evans, of Maryland, whose name will always deserve to be mentioned in any notice of the Light-House system of the United States, was accepted and authorized by Congress.

By this authorization a permanent Board has been constituted with powers sufficient, it is believed, to carry out the aim and intention of Congress. It can hardly be amiss to add, that the character of the members composing it, offers a safe pledge of the judicious energy with which the necessary rectifications and improvements will be carried out. To their courtesy is owing the opportunity of showing the present Lens which stands among the chiefest objects of enlightened interest in the Exhibition.

GLASS.

ALTHOUGH the display of glass in the present Exhibition is very far short of what it ought to have been, to satisfy public expectation and the inherent interest of the subject itself, still there is enough in this class to convey much instruction, and to excite a praiseworthy curiosity to know something more of the art of glass making than is commonly the share of intelligent people. We propose in this article to present a concise and untechnical account of the art, drawn from the most reliable sources.*

The origin of glass making is lost in the shades of an antiquity so remote that it is not easy to distinguish fable from history. To the former most certainly belongs the absurd legend so often quoted from Pliny, that glass was first formed accidentally by Phœnician dealers in native soda, who, halting on the shores of the river Belus, and resting their kettles over the fire upon lumps of soda, caused the sand of the shore to form glass with the alkali. A single fact is worth all the speculation which ingenuity can invent, and such an one is supplied by the researches of Layard among the ruins of Nineveh, where he found a perfect and beautifully formed vase of glass, now in the British Museum. It bears the marks of having been turned in a lathe, a process never attempted in our times. The maker's name is also engraved on its foot, and the circumstances attending its discovery authorize the belief that it dates at least seven centuries before the Christian era. The same indefatigable antiquarian has also discovered in the ruins of the same city a convex lens of rock crystal, proving that the ancient Assyrians were, to some degree, familiar with the properties of light, as well as with chemistry. The inference seems well sustained also, that Archimedes was acquainted with the scientific uses of glass, whether he used it or not for the purpose of setting fire to the fleet of his enemies, as is usually related of him. Sir Gardiner Wilkinson (Vol. iii. p. 88), copies from a painting of Beni Hossan the representation of two glass blowers inflating by hollow rods a mass of molten glass. This Theban monarch reigned about 3500 years ago (1647 B. C.) and long before Moses became a pupil in the schools of Pharaoh. Wilkinson adds that "Glass vases, if we may trust to the representations in the Theban paintings, are frequently shown to have been used for holding wine as early as the Exodus, about 1490 years before the Christian Era." We are led by numerous facts to entertain the conviction, that the Egyptians were well acquainted with many chemical processes, and that they attained considerable proficiency in the practice of the chemical arts. This empirical knowledge was with superstitious care confined to the order of the priesthood, and was probably involved in the same mystery that shrouded their religious rites with the design to magnify the holy office, and to inspire the people with a belief in the divine origin of the sacerdotal powers. Pliny in his chapter on this art (lib. 36, cap. 25), gives a curious and very interesting account of the glass houses in Sidon and in Alexandria, which proves not only the early knowledge of the art of glass making, but also that the ancients practised the modes now in use for cutting, grinding, gilding, and coloring.

However uncertain, therefore, may be the date of discovery of this most useful art, it is certain, not only from what has been quoted, but also from all the other accounts from antiquity that have come down to us, from Herodotus, Strabo, Theophrastus and others, that the art was very early known, and carried to a high degree of perfection. It is, however, equally certain that its use in early times was much restricted, and that even as late as the reign of Tiberius, after the knowledge of Egypt had been transplanted to Rome, goblets and vases of glass were regarded only as decorations for the tables of the Emperor and his wealthy patricians. The Portland vase is the most beautiful specimen extant of these ancient goblets. It was found in the sarcophagus of Alexander Severus, who died A. D. 235, and is now in the British Museum. It is curious as showing the perfect state of the art at that time, being formed of a deep cobalt blue body, covered by a white enamel, in imitation obviously of the onyx agate. The exquisite relievo figures upon it are the result of cutting away this white surface, and exposing the dark ground, as was the custom in the hard stone seal engraving of the ancients.

It has been doubted whether glass was ever fashioned by the ancients in sheets for admitting light in windows, but we remember to have seen in Pompeii a circular disc of glass 12 or 14 inches in diameter, filling its original place in a circular window in one of the recently excavated houses of that ancient Roman city. It should be borne in mind also, in forming an opinion on this subject, that the style of architecture in those days excluded windows, in accordance with the climate and the habits of the people, which rendered them needless unless in rare cases. The antiquarians assert that the circular opening in the dome of the Pantheon at Rome, was originally filled with one immense sheet of glass, but this may well be doubted.

According to the local tradition of Venice, the manufacture of glass is cœval with the existence of the city itself; and a series of decrees of the Republic, commencing at the latter part of the 13th century, show that the art was carefully promoted until a change in the public taste deprived Venice of her profitable monopoly. In the 13th century, glass houses became so numerous as to expose the city to danger by fire, and in 1291, all the establishments were ordered to be removed to the separate island of Murano.

The skilled Greek workmen who escaped the taking of Constantinople in 1453, taught the Venetians to enrich their productions by coloring, gilding, and enameling. Early in the 16th century they invented a delicate and enduring mode of enrichment—the introduction of threads of colored and opaque white glass into the substance of the vessels. For two centuries the Venetians monopolised the glass trade of Europe; but at the commencement of the 16th century, heavy cut glass became fashionable, and the trade being dispersed to Bohemia, France, and England, the manufacture of filagree glass lost its importance, though

* The article Glass in the Encyclopedia Metropolitana; that in Knapp's Chemistry applied to Manufactures, Vol. III.; the Essay in the London Jury Reports, 1851, p. 521; and the chapters in Dumas' Chemistry on the same subject, form the most important and accessible papers upon glass.

it has always been continued on a limited scale. Indeed, the Bohemian glass, and the Venetian with its slender, graceful forms, and curved spiral stems, parti-colored, engraved, or plain, have never been surpassed either in beauty of form, or excellence of materials, nor have they even been successfully imitated elsewhere until a very late period.

Such is a brief historical sketch of this art. Let us now attend more particularly to its details.

Glass is, essentially, a compound of silica (the *flint* is nearly pure silica), rendered fusible by an alkali, as soda, potash, or lime. Sometimes one of these, but more commonly two of them, and occasionally all three, enter into the constitution of glass. The oxyd of lead, is also an important constituent of what is called flint glass. This metallic oxyd has the remarkable property of dissolving large quantities of silex, and of giving to the colorless glass which it forms a peculiar brilliancy, such as can in no other way be procured. Such glass is also peculiarly heavy, and to its density owes the high refracting power which it possesses. In a chemical sense, glass is regarded as a salt, and belongs to the large family of *silicates*, of which numerous examples are to be observed in nature. Glass is, however, peculiar in this respect, by which it is distinguished from nearly all natural compounds of silex, namely, that it is entirely without any crystalline structure. Its particles on cooling assume no regular internal arrangement, they are homogeneous, but are without form, or amorphous, as it would be expressed in mineralogical language.

Silica by itself is a very infusible substance, and by no means could it alone be formed into vessels by aid of heat. In its most pure form it occurs in beautiful transparent colorless crystals, called rock crystal or quartz, exceedingly hard, and not easily reduced to powder. Silicious sand is found, however, in many places remarkably pure, and some saudstones exist that are quite pure enough to answer the purpose of the glass house. Flints found so abundantly in the chalk cliffs of England, are also nearly pure silica, and being heated and quenched in water, they crumble easily, and form the material of a large part of the English glass. The term flint glass came thus into use. In this country fine glass sand is found in the county of Berkshire in Massachusetts, at St. Genevieve in Missouri, and at St. Paul's in Minnesota, on the Mississippi River. A specimen of the latter (which is as yet only imperfectly known to the manufacturer) exists in the Mineralogical Cabinet of the Association (No. 181 Mineralogical Catalogue). M. Le Duc, the Minnesota Commissioner, who deposited this specimen, has placed beside it a specimen of flint glass made from it, which is remarkable for its purity of color. The flexible sandstone from North Carolina (No. 163, Class. 1), would also, no doubt, prove a good glass material. The existence of a very small quantity of any of the compounds of iron, destroys the value of the sand in which it is found, from the color which it imparts to the glass made from it.

The heat required to fuse glass depends very much on the quantity of flux (alkali or oxyd of lead), which is used in forming the compound, but the good qualities of the glass require that no more flux should be employed than will render it easy to fashion the vessels in the process of blowing. In badly compounded glass, so much alkali is sometimes used that the resulting glass is soluble in water, thus destroying one of its most essential qualities, and rendering it valueless, and where a much less excess is used it still causes the glass to sweat, or attract moisture to its surface, and finally to become rusty or opaque. In the strictest sense all glass is somewhat solublo. The very hardest chemical glass when finely pulverised and moistened with water, yields an alkaline reaction to tests, and water which has been boiled for some time in a vessel of glass is found to contain appreciable traces of silica. Soda when employed alone, or in connection with lime, gives to the glass made from it a greenish color, more or less decided, while potash salts give a yellowish tint. To correct this color in soda glass, and to remove any tint of a similar color from small quantities of iron present in the sand, it the custom of the glass blower to use some metallic oxyd, which will aid in decolorizing the product. This is accomplished either by a change which the oxyd produces in the chemical componnds present (e. g. as by reducing the peroxyd of iron to the condition of protoxyd, which forms nearly colorless compounds when cold), or by supplying another color complementary to the offensive one, thus rendering the product colorless. Black oxyd of manganese is such a substance, and has been long used by tho glass makers for this purpose, and as it seemed to the uninformed workmen to wash out the color of their material it was familiarly called glass maker's soap. It requires to be used, however, with great caution, as it possesses the power of giving a pink, amethystine, or deep violet color to the glass, when present even in slight excess. Its power to neutralize the green color of soda glass is probably owing to the optical effect of the red color of the manganese compound, which, when not in excess, would prove exactly complementary to the green, and white glass would result. It is, however, quite common to see in glass articles of common use, a violet tint in tho thicker parts (as in the bottoms of tumblers), due to the manganese. The white oxyd of arsenic is another substance constantly used in the glass house to decolorize glass, as well as to render it, when used in excess, opaline or opaquo. Borax and nitre, more costly substances, are less often employed as decolorizing agents, although they possess this property in an eminent degree.

It is thus plain that a good deal of science connects itself with the glass maker's art, and that it is indeed truly a chemical art. To its improvement the first chemists living have devoted much attention, and the scientific principles involved in the selection and compounding of the materials of glass, and of the pots in which it is fused, are perfectly understood, and the success of the art depends on the skill and good judgment with which these principles are applied in practice.

Colors are given to glass by the use of metallic oxyds, whose combinations result in the production of various transparent colors. Some foreign substances also, as carbon and oxyd of iron, produce also various shades of color, from mechanical suspension in the fluid glass.

Yellow is produced in cheap ordinary glass by smoke soot, or any other form of finely divided carbon, which in greater quantity renders the glass dark brown or black, but of a dirty and lustreless aspect. Glass of antimony produces a fine yellow in glass, and cheaply. Oxyd of silver, applied in a peculiar way, also forms a delicate orange in glass containing alumina, and most costly of all is the beautiful yellow green formed by the oxyd of uranium.

Red.—This color is produced cheaply by the addition of finely pulverized red oxyd of iron, which, being mechanically suspended in the glass, produces a brownish red color of no great beauty. The *sub-oxyd of copper*, (the scales which are thrown off when metallic copper is quenched in water,) produces a red of great beauty and depth of color. The metallic oxyd was also employed by the ancients to produce red glass, as the analysis of some of their specimens has shown most conclusively. It was used likewise by mediaeval artists in coloring the glass of church windows, and its employment for the same purpose in modern times is but the re-discovery of an old fact. Singularly enough, this metallic oxyd produces its appropriate red color in perfection only after the glass has been cooled and heated a second time. It is in the first instance, on leaving the crucible, nearly colorless, with a slight tinge of green, and becomes deep red on reheating, a change which has not been well explained. Should any decolorizing material be used in connection with sub-oxyd of copper, the glass will be colored green instead of red, the sub-oxyd (Cu_2O) being converted into the oxyd (CuO) of copper, which produces green tints. Its coloring power is very intense, and any considerable mass or thickness of glass containing it appears black. Hence it is almost invariably used only to *flash* or cover one surface of vessels to be colored red.

Gold in the form of the purple of Cassius, (a compound of gold and metallic tin, produced by cautiously precipitating a solution of gold by one of tin,) will produce a brilliant red color in glass, which may be graduated to produce scarlet, carmine, rose, or ruby tints. This color is very powerful as well as expensive, one part of gold, it is asserted, producing a decided rosy tint in 30,000 parts of glass. The same peculiarity obtains in this color also that was mentioned of the copper red, namely, that glass colored with gold is nearly colorless or slightly yellow, until it is cooled and heated a second time, when it assumes its proper tint. The *Bohemian ruby glass* is a peculiar color prepared in special manufactories, and sold in cakes to tho manufacturer; but the essential thing is after all gold in one of its forms of combination, (viz., fulminating gold.) The Bohemian ruby contains no tin, which probably, by its tendency to form opaline or milky glass, may have an unfavorable effect on the rose color, while a small quantity of oxyd of antimony added in the Bohemian red glass, heightens the brilliancy of the ruby tint. *Manganese*, as already stated, produces an amethystine tint in glass, a peculiarity belonging to the peroxyd only, as the protoxyd of manganese gives no colors.

Green.—This color is produced cheaply in common ware by the use of *protoxyd of iron*, but this color is feeble and of little brilliancy; but mingled with protoxyd of copper, it forms a beautiful emerald color. A grass or yellow green is produced by using the sesquioxyd of chromium, a substance abundantly obtained from the chrome iron ores of Maryland and Pennsylvania, (No. 137, class I.) In Bohemia, the "modern emerald green," as it is called, is produced from a mixture of the oxyds of nickel and uranium. The preparations of antimony mingled with oxyd of copper, also produce a fine green color.

Blue is produced almost solely by the use of oxyd of cobalt, a metal associated with nickel, and whose oxyd possesses the power of imparting a decided bluish tinge to at least twenty thousand times its weight of glass. The exquisite blue color produced in glass by oxyd of cobalt was known long before the separate existence of cobalt as a metal was suspected; and the manufacture of glass colored with it, under the name of *smalts*, and used for giving color to pottery ware or glass, has been carried on in Germany for centuries. Zaffre is another name by which tho impure oxyd of cobalt thus prepared is known in commerce. Cobalt and nickel are found at several places in the United States, and specimens from Connecticut and Maryland are in the present Exhibition, (Nos. 23 and 135, class I.)

Tho admixture of the primary colors just enumerated gives to the glass-maker tho power of producing an almost endless variety of tints. The effect of opalescence is gained by tho use of arsenic, of oxyd of tin and alumina; and bone earth (phosphate of lime) is added to produce opacity or milkiness. Black is usually produced by using some coloring matter in excess; not being a color, but only its absence, black is inconsistent with transparency.

Enamels are formed by the use of tho colors already named, with a lead glass

rendered opaque either by oxyd of tin or antimony, and so fusible as to be easily managed by the heat of a table lamp.

The manufacture of glass is divided into a great number of distinct branches, founded on differences of composition and of use, from which is derived the following classification:

A. Window glass, including sheet glass, crown glass, and colored sheet glass. This glass is composed of silica, soda or potash, lime, and alumina.

B. Painted and other kinds of ornamental window glass. Composition much the same as section A.

C. Plate glass, whether cast, pressed, or rolled. Composed of silica, soda or potash, lime, and a little alumina; and differs from section A only in the greater purity and colorlessness of the materials employed.

D. Bottle glass, including,

a. Ordinary bottle glass, consisting of silica, potash or soda, alumina, and oxyd of iron.

b. Medicinal bottle glass, composed of silica, potash, lime, some alumina, and a trace of protoxyd of iron.

c. White bottle glass (in a limited sense,) for bottles, tumblers, tubes, and chemical glass, &c., and composed of silica, soda or potash, and lime, very infusible.

E. Flint glass, or crystal, usually composed of silica, potash, and oxyd of lead; and used for ornamental table glasses, chandeliers, lamps, beads, Venetian glass weights, aventurine, glass mosaic, and when peculiarly pure, for the basis of imitative gems.

F. Optical glass, both flint and crown, the former composed of silica, or boracic acid, potash, and more lead than is usual in flint glass; the latter composed of silica, or boracic acid, potash or soda and lime, these materials being of the greatest purity.

The limited use of glass for windows both from its greater rarity and cost in olden times has been already alluded to. Sheets of transparent gypsum, and plates of mica, have been used for windows in countries where these minerals are found in pieces of sufficient size. It appears that as late as the close of the 17th century, common houses in Great Britain were unprovided with glass, and even in the palaces of nobles it was regarded as an article of splendid luxury. The venerable Bede, in his history of the planting of the church in Britain, gives a particular account of the ornamental glazing with painted glass of the churches and monastic houses of Yarrow and Wearmouth, by artists whom the Abbot Benedict brought over from Italy for that purpose in the latter part of the seventeenth century (see Howitt's Visits to remarkable Places, article Bede). This is probably as early as this art was practised in any part of Europe.

In the sixteenth century the diamond was first employed to cut glass, and this circumstance has probably exercised a controlling influence upon the general use of glass for architectural purposes. Indeed, it is hard for us to imagine how the manufacture and use of window glass could be carried on at all without the diamond to cut it with ease and certainty to a required size.

Window glass is chiefly of two sorts, named, in allusion to the mechanical processes employed in their manufacture, viz., 1. Sheet-glass formed by the flattening of blown cylinders, and 2. Crown-glass, formed from a blown sphere by the effect of centrifugal force.

Before describing these two processes and their results, let us briefly advert to a few facts, familiar to all who are acquainted even slightly with the processes of the glass house, but which may not be so generally known as to render some allusion to them unimportant. The materials of which glass is formed are mingled in weighed quantities, and in a dry state, upon a floor prepared for the purpose. The melting pots, which are designed to hold from 500 to 2000 pounds of materials, are formed of the most refractory fire clay, to which is added a certain quantity of the pulverized fragments of old pots. They are fashioned with the greatest care, the clay being tempered for months, and have the form of a cylinder or frustum of a cone. Several of these pots are set in a circular furnace heated by wood or bituminous coal, and sustained on strong flat arches. The opening of each pot is directed outwards for convenience of charging the raw material, observing the progress of the fusion, and withdrawing the product. It is also important that the products of combustion, and the smoke of the fire should have no access to the materials in the pots, hence their tops are arched, and the fire plays only on their exterior. The heat is raised until the pots are fully red hot before the charge of weighed materials is introduced. This is accomplished in several small portions added successively, an interval being allowed after each addition for the mass to become fully heated before another is made. The chemical action of the materials upon each other under the influence of heat is very simple. The alkali employed is almost always in the form of carbonate of soda or carbonate of potash. Silica has the property at a high temperature of acting the part of a powerful acid, and when the proper degree of heat is attained it drives out the carbonic acid before combined with the alkali, while the silica and alkali unite to form a salt (glass). This action is by no means soon over. The viscid mass has so pasty a consistence at first, that the expelled carbonic acid escapes very slowly, filling the whole mass of materials with numberless cavities and air cells, so that even at the end of 24 hours the glass in the pot resembles rather a loaf of light bread than the transparent material we are wont to see. When the materials are incautiously added, or the heat raised too suddenly, this escape of carbonic acid sometimes occasions the frothing over of the pot. From time to time the workman withdraws a portion of the glass upon the end of his iron blow pipe rod, and fashions it into some form from which he can judge of the progress of the fusion. The glass blower always speaks of the melted glass as "*metal.*" The tools which are used to fashion glass are of wonderful simplicity, the art of glass blowing being chiefly one of manual dexterity. The blow pipe, a hollow rod of iron, protected by a wooden covering over part of its length, a pair of rude scissors, with a spring back like the sheep shearing scissors, a knife, a flat surface of iron (the marver) on which to roll the molten glass, and a solid rod of iron (the punty rod or pontil), are the chief implements required by the glass blowers. Of moulds, now so much used to fashion vessels of all sorts in flint glass, we shall speak more particularly by and by.

When by trial the *metal* is found to be sufficiently refined, the heat is somewhat reduced to permit the glass to assume that pasty consistence, resembling thick honey, which is essential to enable the blower to manage it with ease. We we will suppose that sheet glass for windows is the object to be formed, and that of the best quality, perfectly white. The materials that have been found best fitted for this purpose are 100 lbs. sand, 52½ lbs. of purified potashes, 14¼ lbs. of chalk, ¾ lb. of peroxyd of manganese, and 125 lbs. of broken glass of a former operation. The lime is required to prevent the glass from corroding when exposed to the atmosphere. The most colorless window glass when seen edgeways has always a yellowish tinge.

The workman now introduces his pipe into the pot of metal, and collects a sufficient quantity to form the cylinder he is about to blow. The ponderous globe of solid glass thus withdrawn is rounded on the marver, and pushed forward on the rod by means of a knife, so as to be attached to it by a grooved neck. He is aided in this process by placing the glowing mass in a globular or pear-shaped cavity in a block of wood kept moist by water. The mass, reheated at the furnace, is now inflated until a considerable cavity is formed, and the mass has a pear shape. By a rapid motion the workman next raises the mass over his head, still inflating it. Gravity causes the plastic metal to assume a flattened form, and the pressure of inflation, which now distends the sides only, is continued until the diameter of the flattened bottle is equal to that of the intended cylinder. Another rapid downward movement lengthens the heated and now pendulous mass without diminishing its diameter, and now the workman swings his pipe from side to side like a bell clapper, inflating from time to time, until under the united influence of gravity, inflation, and incessant motion, a perfect cylinder is formed. Often it is requisite in the course of these operations to reheat the glass several times, but sometimes an adroit workman will carry forward the operation to its present stage at one heat. Next he presents the end of the newly formed vessel to the fire, resting it in a crotch, on which he can revolve the work before the flame. A strong blast, or even the expansion of the air imprisoned by the thumb closing the opening of the pipe, will occasion the heated end to puff out, and thus to form an irregular opening. The cylinder thus opened, the aperture is made regular by an assistant who cuts the ragged edges with scissors, while the workman fashions the still pliant glass with the edge of his scissors, revolving it all the time into a perfectly symmetrical form. The blow pipe and its attached cylinder is then revolved adroitly over his head, and with great speed through an entire circle several times, by which it is cooled before it loses its regular form. The application of a thread of red-hot glass to the cooled surface of the cylinder near the end of the blow-pipe, occasions a neat separation of the parts by cracking. We have now a cylinder of glass open at both ends, uniformly thick, and of a fine lustre. Good specimens of these may be seen in the Holland Court of the Exhibition, Class 24, No. 2. It now remains to open the cylinder and flatten it into a square sheet. For this purpose it must be carefully reheated in a furnace of peculiar construction. At the moment when the cylinder has been brought to the proper temperature, it is opened lengthwise by applying a drop of water or by a cold iron, and the workman adroitly opens the cylinder, and spreads it upon a hard table, by gently pressing against its sides with a rule. The surface of the pliant glass is then flattened with a polisher of iron or wood, and the sheet is passed into another chamber where it is slowly cooled and tempered.

Such is a brief account of the method of blowing cylinder, spread, sheet, or broad glass, for it has all these names. It is afterwards cut up by the diamond into any required sizes. This sort of glass is recommended by its cheapness and uniform thickness, &c. As the process is now conducted it is equal to any blown glass. When carelessly made, however, it has a very wavy, uneven surface, and a deficiency of lustre.

We have dwelt with more particularity on the steps of this process, as they are essentially the same with the operation of blowing vessels of every sort. Thus the cylinder of glass in its various stages of progress represents a variety of vessels, and should the operator stop at one of them he would form a bottle, at another stage a chemical vessel or air bell; and it is only the last operation of opening the cylinder which distinguishes it from the usual glass blowing pro-

cesses. The shades so much in use for covering clocks and small articles of vertu, are made by the cylinder process of blowing.

Crown Glass.—As gravity and inflation are the simple means by which cylinder glass is blown, so in crown glass resort is had to the effect of centrifugal force to produce a wheel of glass out of a *globe* previously formed by inflation and gravity. The metal employed for crown glass may be the same already described, or any other hard glass material. The workman gathers the glass upon his pipe with the same precautions which are adopted when cylinder glass is to be blown, but he proceeds to blow a sphere or hollow globe, with walls as evenly thick as possible. The furnace before which he operates has a circular opening called the *glory hole*, from which a powerful radiation and flame proceed. This fire is fed by powdered rosin thrown in from time to time in small doses by a boy stationed near by. The globe being formed is brought before this hole and rapidly revolved on a crotch conveniently set for the purpose. An opening is made in the apex opposite to the point of attachment, as in cylinder blowing, but the process afterward is entirely different. By the exposure to the flame of the glory hole, the revolving and now opened sphere, becomes flattened at the pole by centrifugal force; the opening, at first small, gradually enlarges; and the whole vessel flattens under the rapid revolution of the pipe, the workman approaches the flattened surface nearer and nearer the flame, the opening still widens, the original globular form is exchanged for that of a flat vessel with contracted edges; the heat and revolution are now at a maximum, when suddenly the whole mass *flashes* into a regular wheel, nearly six feet in diameter, of which the pipe is the nave. Hence this process is technically termed "flashing." The wheel still glowing with fervid redness would at once collapse and fall into a useless mass if the revolution was suddenly checked; hence the workman gradually withdraws it from the fire, which is also reduced in fierceness until the glass has become cool enough to retain its form. It is then detached from the pipe by the touch of a cold iron at the point of contact, and the wheel still very hot is passed into an oven called an annealing kiln, where it cools very slowly, in order to temper the glass and render it tough. The wheels thus formed are never quite flat, but are always a little arched, or crowning from the edges to the centre. Hence the term *crown glass*. If the process has been skillfully performed, the sheets cut from the wheel are remarkably uniform in thickness, but there is always a bulge at the centre called the "bull's eye," and this limits the size of crown glass to about 36 inches in its largest dimension.

The lustre of crown glass is always superior to that of cylinder glass, which is owing to its being exposed to the high temperature of the flame during the flashing, and also to the fact that it is completed, so to speak, at one operation, while cylinder glass is several times cooled and reheated, a process which tends to devitrification, and would if often repeated render glass nearly opaque like porcelain.

Colored sheet glass for church windows, &c., is rarely colored in the pot, but a good quantity of hard glass is selected and colored of the desired tint by one of two processes. The first consists in dipping the pipe into a crucible of molten glass of the desired color, and gathering a small quantity on the end; it is then dipped into the pot of *hohl* glass, and the requisite quantity for the cylinder operation accumulated as usual. The process of blowing already described, must, as will be easily understood, result in spreading the colored glass all over the extended surface of the cylinder in a thin film, like a transparent veneer. This is the usual process on the large scale, and is the mode before alluded to as practised in giving the Bohemian ruby to vessels of that color.

The other process employs the enamelling furnace in which the glass to be colored is heated until a fusible paste, with which its surface has been previously covered, is melted and flows over, adhering to the glass, and acquiring at the same time the desired color from the mineral oxyds which had been added to the paste. That paste is always of fusible lead glass, ground to a fine powder and laid on the glass surface with a brush and water. This last process is employed to produce painted glass, on which it is designed to show more than one color or tint.

Cast Plate Glass.—Plate glass is made by a process entirely distinct from those employed in producing window glass. So far as we are informed, this division of the glass manufacture has not been as yet established in the United States; nor is it by any means a common branch of the business in the Old World, where it is comparatively a modern art. Abraham Thévart is regarded as the originator of the idea of casting the molten glass from the fusion pots upon a table of metal. This was at the close of the seventeenth century (1688) and the St. Gobian establishment, still so celebrated for its plate glass, was founded by him. The Venetian plates were ground down from blown glass preparatory to silvering, a process still in use for cheap mirrors. In England the first company, "The British Plate Glass Company," was established in Lancashire as late as 1773; although the second Duke of Buckingham, who imported his workmen from Venice, had previously met with much success in making plate glass for mirrors and coach windows at Lambeth.

Plate glass is a soda lime glass, soda being preferred because of the much greater fluidity which it gives to the molten metal. The proportion of materials used at St. Gobian are 100 parts of pure sand, 35 pure carbonate of soda, 5 of air-slaked lime, 100 of cullet or broken glass, and such decolorizing materials (ox. manganese) as are needed. The furnace employed is peculiar, it being necessary to ladle out the melted glass from the fusion pots into quadrangular cisterns called *cuvettes*, formed of the most refractory fire-clay. The materials are fused in the circular pot in about 16 hours, and the metal is then carefully skimmed with a copper blade, taken out in copper ladles, and turned into the cuvette. Care is taken not to disturb the unfused particles of sand and various impurites which have settled at the bottom of the pot. In the cuvette the glass remains 24 or even 48 hours, until it is perfectly fined; the heat is then somewhat abated for three or four hours, that the glass may fall to the proper temperature for casting. Preparatory to this, one of the movable walls of the furnace is taken down, and a pair of strong quadrangular tongs are attached to the cuvette, and by their aid the glass is poured out upon the casting table. This table is of cast iron 10 or 15 feet long, half that breadth, and 6 or 7 inches thick to prevent its warping when heated on one side. The surface of the bed-plate is first heated by hot coals, so as not to chill the melted glass too suddenly, and while one set of workmen are again preparing this surface quite clean, another set have removed the cuvette and hung it in a crane. Being brought into this position, its contents are turned out in a fiery cascade, which is kept within certain bounds upon the table by iron guides, while, at the same time, a heavy iron cylinder is drawn forward on its axis, and pressing upon the molten surface, produces a plate of uniform thickness and solidity. The lower surface in contact with the bed is not so smooth, but is more accurately level than the upper surface. In five minutes from the time when the cuvette left the furnace, the cast plate is slid off from its bed by a proper tool into the annealing arch, where it rests on a bed of sand for 12 or 14 days before it is considered safe to remove it. Next comes the laborious process of grinding after a selection has been made of those plates which are judged to be most perfect. This is accomplished by coarse sand and water strewn over the upper surface of the plate, the lower being firmly bedded in plaster of paris. A smaller plate of glass attached to a stone, and heavily weighted, forms the muller, and this is moved either by machinery or by hand. After the coarse sand has reduced the surface to one plane, emery in different grades is employed to make the plane surface smooth, and finally the polish is given by red oxyd of iron (colcothar or rouge) applied on cloth backed by wood. Now, when it is remembered that 7 grades of sand, and 15 of emery are used, besides the colcothar, and that this series of processes is to be repeated for each side of the plate, it will readily be understood that the preparation of large mirror plates must be a very costly and time-consuming affair. Moreover, it is only after the fine grinding that the blemishes in the substance of the glass appear (air bubbles and discolorations), requiring the plates to be cut into smaller ones to save them from total loss; and added to all other sources of cost is the danger of fracture in such repeated handlings and so many mechanical operations. There is need, too, of the most scrupulous care in the choice and compounding of the original materials as well as in the casting, that blemishes of color, and irregularities in the inherent structure of the glass, or striæ, may be avoided; since the first and last requisite of a perfect mirror is the power of rendering an exact reflection, both in color and form, of the objects before it. The same care is therefore needed in the manufacture of this description of glass as in the preparation of glass for optical purposes. It is not wonderful, then, that large mirror plates should be very costly, nor that a heavy capital should be required to conduct the manufacture with advantage.

We trace the history of our modern silvered mirrors (i. e. tin amalgam) to Venice, where they were produced by the present process in the 16th century. The ancients employed small metallic mirrors, highly polished, the form and construction of which we see perfectly in the specimens from Pompeii preserved in the Museo Borbonico, at Naples. The process of "silvering" glass mirrors is very simple. The sheet of tin foil, somewhat larger than the mirror, is laid upon a smooth table, and quicksilver poured over it until it covers the tin foil with a thickness of one-tenth of an inch or more; when the mercury has been swept by the edge of a stick to clean off the drops from its surface, the glass plate scrupulously clean is brought even with the edge of the table, and pushed gently forward sideways, so as to slide over the bath of mercury, its edge just dipping beneath its surface, so as to push before it all impurities, and to exclude all air bubbles. Weights are then evenly applied over the back of the mirror, and the whole table inclined to such an angle as to favor the drawing off of the superfluous mercury. This requires some days or weeks, according to the size of the plate. [illegible] additional risk and cause of cost in large mirrors, since the time consumed is not small, and the danger of fracture imminent. The amalgam sometimes crystallizes, producing imperfections which require the renewal of the whole process, and the health of those engaged in it also suffers, and is finally destroyed by mercurial salivation.

Silvered Globes.—It must have attracted the attention of the most casual observer, that within the last few years spheres of glass, sometimes of large dimensions, have appeared in our shops, brilliantly lined with a silver coating. These globes obviously cannot be covered on their interior by the amalgamative process just described for mirrors, and the reflecting surface is really what it seems to be, a film of metallic silver. This is put on by an extremely simple process, known

as Drayton's process. The silvering fluid is composed of one ounce of nitrate of silver, three ounces of alcohol of 87 per cent., and 20 or 30 drops of oil of cassia. Metallic silver is deposited from this fluid upon the addition of a *reducing liquid* composed of one part of oil of cloves dipped in three parts of alcohol. The silver begins immediately to be thrown down, but the experiment succeeds best when the process goes on slowly, and from the addition of a few drops (say six or eight drops) of the reducing fluid, which suffice to precipitate the silver of 4½ oz. of solution. The film of silver does not exceed 15 or 20 grains in weight for a foot of surface. Flat mirrors can be thus silvered as well as globular vessels, and the cost of silver upon a mirror 5 feet by 10 would not exceed two and a half dollars. There are, however, it is said, practical difficulties in the ways of employing this process on a large scale, but for the silvering of the interior of glass vessels it is invaluable. The precipitation of the silver in this process is due to the deoxydizing influence of the volatile oil, and many other organic compounds possess the same power over the oxyd of silver.

Bottle Glass is extremely various in its composition, since these vessels may be blown from any description of metal. For wine bottles cheapness and strength are the great requisites, and as color is of no moment in this case, materials wholly unfit for other uses may be employed. Thus black bottles are made of 100 parts of sand, 20 lbs. dry glauber's salts (sulphate of soda), 18 soap boiler's waste, 200 of refuse glass, and 45 of basalt. For ordinary green glass bottles, 100 parts sand, 72 of lime, and 280 of lixiviated wood ashes. Champagne bottles require 100 parts sand, 200 feldspar, 20 lime, 15 common salt, and 125 slag from the iron furnace.* White bottles for medical and chemical use are blown from any good quality of hard glass, but those for chemical use should contain neither lead nor arsenic, and no more alkali than is requisite for fusion. Insolubility and power to resist chemical action, are indispensable qualities in chemical vessels. No glass is absolutely insoluble, as even the hardest Bohemian white glass (a lime-potash glass), when pulverized and moistened with water always yields an alkaline reaction to test papers. Tubes of glass for chemical use when intended to resist a high temperature, as in organic analysis, are formed of the most refractory metal, such as has been made in perfection only in Bohemia and some other Austrian provinces. This glass is composed of silica 73, potash 113, soda 3, lime 105, alumina, &c., 2=100. The usual glass for chemical use is formed from 100 lbs. white sand, 41.4 potashes, and 17.5 of lime. Glass of this composition is not easily fused, and is more difficult to work than that which contains more alkali. In comparing the composition of the coarser sorts of bottle glass, one is struck with the resemblance, between them and some other natural products, like obsidian and lava, which are fusible silicates of alumina and iron, with variable proportions of lime, magnesia, and the alkalies. We may in fact regard these volcanic products as nature's glass.*

Flint Glass or Crystal.—Some confusion exists in the use of these terms, owing to the fact that flint glass is a term usually restricted to that description of glass of which oxyd of lead forms an important constituent. This is not, however, strictly true, as the Bohemian flint glass contains no lead at all. We may define flint or crystal glass to be that description of glass which is fitted from its comparative softness for easy grinding or cutting on the polishing wheel, and which also has a high refracting power, and is thereby best adapted for articles of beauty and luxury, in which brilliancy of lustre is desired. It was remarked at the opening of this essay that the oxyd of lead had a most remarkable power of dissolving silica, and that the glass formed by it was distinguished by its brilliancy, easy fusibility, and weight. The use of oxyd of lead in this art was first resorted to in England in the 16th century, as an expedient to procure a more easily fusible glass, in order to avoid the waste of fuel required to heat close or arched pots to the proper temperature by means of coal, the only fuel available in England, and one incompatible with the use of open pots. It was soon discovered that the lead was not only an excellent flux, but that the glass made by it had superior beauty from its high refracting powers. Subsequently the use of lead was adopted in France, but in Bohemia and Venice they still make crystal glass without its use.

The Bohemian crystal for grinding is composed of 100 parts white sand, 60 pure potashes, 8 chalk, 40 broken glass, and 1¼ manganese. The English flint glass is composed of sand, minium, and potashes, all pure as possible in the proportions of about 3, 2, 1. In addition manganese or arsenic is used as a decolorizing material; if the former is selected, care is taken that it is pure, and especially that it is free from iron. Minium, or red lead, ($Pb\ O_2$) in the process of fusion parts with one atom of oxygen to form that oxyd ($Pb\ O$), which unites with the silica, and this liberated oxygen acts to decolorize the glass. With the same object a part of the carbonate of potash may be advantageously replaced by its equivalent of nitrate of potash (saltpetre), which acts favorably by the large volume of oxygen it parts with at a high temperature. More silica can be used with wood fuel than with coal. Thus the composition of flint glass is stated:

	With coal as fuel.	With wood as fuel.
Sand washed and calcined,	100 lbs.	100 lbs.
Minium (oxyd lead),	70 "	45 "
Purified Potashes,	30 "	35 "
Cullet, or broken glass.		

The fusion of these materials occupies six or eight hours, and the fining as much more, during which the glass must be protected from the smoke and products of combustion, the action of which would reduce the oxyd of lead to metallic lead, and so blacken the product. Eight crucibles or pots are usually set in one large circular furnace all heated by one fire, which is conducted by the flues so as to surround the pots on all sides. In England and the United States it is usual to commence the *found* or fusion of the materials on Friday night, and to leave the metal until Monday morning before commencing work, during which time it becomes perfectly fined. It is in this department of glass manufacture that more progress has been made than in any other in the United States, and the best results obtained. The Brooklyn Flint Glass Co. (Class 24, No. 1, U. S.), and the New England Glass Co., Boston (Class 24, No. 4, U. S.), are the largest manufacturers, and their display in the present Exhibition of dioptric lenses, and signal lamps, and of plain, pressed, cut, and decorated glassware, is decidedly creditable to this country. The American flint glass is distinguished by its brilliancy and the purity of its color, and that of the New England Co., is the best pressed glass probably ever manufactured. The composition of the New England Glass Company's wares is as follows:

Best colorless sand, - - -	300
Minium, - - - -	200
Refined Pearlash, - - -	100
Cullet and manganese, or arsenic.	

When requisite, a part of the pearlash is replaced by nitre. The art of moulding or pressing glass in metallic moulds as a substitute for blowing and cutting, it is believed, is entirely of American origin, and although adopted to some extent in Europe, the products there are very inferior in beauty. Indeed the process of moulding glass, so far as we can learn, is used in Europe only as a preparation for cutting, the labor of which process is thereby very much reduced. But the New England Company have brought the process to so much perfection, that their drinking vessels are made by it of such finish and beauty as to deceive the eye, except on close inspection, with the idea that they are cut. We have taken some pains to ascertain the history of this branch of glass making in the United States, and have been obligingly furnished with some facts relating to it by Mr. Jos. N. Howe, the Agent of the New England Company. It appears that moulded glass has been made for a long time in a certain rude form, but that in 1826 Mr. Enoch Robinson, then in the employ of the New England Company, took out letters patent for the invention of a process by which furniture knobs, door handles, &c., were made of pressed glass. The validity and originality of this patent was fully tested by a closely contested lawsuit in Philadelphia, carried on against powerful parties in Pittsburgh. In 1827 Mr. Robinson, against the ridicule of the craft, succeeded in moulding a salt stand, and various other articles for table use, and from that time the invention, as one of general applicability, may be considered as established. In 1832 about £100 sterling in value of the Boston pressed ware was taken to London by Mr. Ryan, an Englishman, where the articles in question excited much curiosity and sold profitably. But it was only so late as 1837 that a thin vessel like a drinking glass was fashioned by the pressing process, which branch of the manufacture has since steadily increased. The show of pressed articles in flint glass by the New England Company in the present Exhibition is particularly creditable to the high reputation of that establishment, and the more so, that, as we are assured by the agent, the articles shown were not made for this occasion, but were selected from saleable goods on the shelves of the warehouse. Mr. Howe states that the art of pressing glass, as now carried on in the United States, has worked an entire revolution in the business of flint glass manufacture with us, from the increased facility it affords in making the great variety of articles and patterns susceptible of being thus produced, while the diminished cost of production therefrom resulting, has wonderfully increased the competition among rival companies.

From flint glass are formed all the numberless and nameless articles of glass, which are employed as objects of utility or ornament for the table, the toilet, the parlor, or the cabinets of the curious. To attempt the most summary sketch of the numerous processes by which these objects are produced and ornamented, would be hopeless in any reasonable space. A glance at the Austrian and French Courts in the present Exhibition will convey an idea of what modern art has accomplished in this department of manufacture. Our illustrated pages have also been enriched by designs copied from many, of these objects.

We trace to Venice the origin of all ornamental and colored glass blowing, and the processes still in use at Murano are believed to be the same which have been practised there for centuries past. Among the objects thus made which most excite the wonder of those uninformed in the steps of the process, are the

* We may mention here the specimens of "Lava Ware," manufactured from the slags of iron reducing furnaces, exhibited by Dr. Wm. A. Smith, of Philadelphia, Penn., (U. S. Class 27, No. 19). Dr. Smith claims that he has found important uses for the slags of the iron furnaces which have heretofore been waste products. He exhibits black bottles, tiles and square slabs moulded from this material, which, as we understand, is subject to a second fusion, although it is perhaps possible to work it from the original heat of the furnace.

spirally colored drinking vessels, the letter weights with interior clusters of flowers and other colored ornaments, beads, aventurine, &c.

We will briefly describe some of these processes as we have seen them practised in the ancient glass houses of Murano. Nowhere is the art of producing numerous and brilliant tints of colored glass better understood than in Venice. The pot metal is employed is the flint glass without lead, although lead is used to render some of the colored enamels more fusible. To take the simplest case, that of a drinking glass whose tall stem involves a graceful spiral of several threads of white enamel in colorless glass. Cylindrical rods of glass about the size of a pen stalk are drawn, and of any convenient length; these are colorless, and also of every tint of color which can be named, transparent, opaque or opaline, as the case may be. A mass of colorless pot metal is taken from the furnace, and fashioned on the marver into a cylindrical form; while this is being reheated, another workman has broken several white enamel rods to the same length as the glass cylinder, and has also heated them to the softening point in the mouth of the furnace. The first workman now brings his heated cylinder of colorless glass, parallel to the enamel sticks, and one by one attaches them to his cylinder by simple contact, accurately dividing the space by his eye so that the enamel sticks are equally distant from each other. He now rolls the compound and still soft mass upon the marver until the white cylinders are incorporated into the substance of the colorless glass, but the relative distances are still accurately preserved. Another assistant with a small mass of hot glass on the end of his punting rod now approaches and fastens it to the fore end of the cylinder of glass still hot enough to yield to pressure; and as soon as the attachment is made the two workmen twist their rods in opposite directions, which has the effect to give a special twist to the glass cylinder and its attached filaments of white enamel. This process is continued until the spiral is judged to be sufficiently close, when the mass is again heated, and drawn out by the ordinary process of drawing glass rods, until it has acquired the desired size. A section from this spiral rod forms the stem of a wine glass, or several bits of equal length, placed side by side and reheated, may be made the means of a new and more complex spiral column by a repetition of the process just described. In this manner rods are found of variously colored spiral threads most tastefully intertwined, every color that can be named being in turn selected and heated in the same manner, alone, or in combination with others. The spirals are now from left to right, and again the reverse, and both are often seen in the same stem or rod. Parallel threads of color are produced with more or less ease. Conceive, then, all the prismatic colors, transparent, opaque, or opaline, combined in an almost endless series of such rods as have been described, and placed at the command of an adroit workman—what wonders can he not produce by their skilful combination? Placed side by side upon a plate of iron in the heat of the furnace, such a series of rods can be brought to the softening point, when they will adhere like so many sticks of sugar candy in warm weather. When they are in this condition a workman approaches with a disc of hot glass upon the end of his rod of such diameter as will measure in one revolution exactly, the breadth occupied by the softening spiral rods. He gently rolls the edge of his disc over the hither extremity of the soft rods, which are immediately gathered by it into a fluted open cylinder. This he further softens at the furnace, and by rolling it on the marver he gathers in the open end until he closes it entirely, then applying himself to inflation he blows whatever form of vessel he will from it, fashioning it by his turning tool and scissors at his pleasure. Thus in much less time than it has required to describe his steps, we have a curious entwined and various colored vessel of oriental grace, a perfect miracle of complexity when we recall the simple elements comprising it.

It is easy to understand that out of the same pliant and parti-colored rod, those ornaments of infinite variety may be formed, whose presence in letter weights has puzzled so many. It is only requisite to a better understanding of this curious product to remember that the white glass forming the transparent mass of the ornament is composed of much more fusible materials than the colored central florets. The latter are fashioned at the blow-pipe table, out of the very spiral and colored rods whose origin has been already described; and before they are inclosed in their crystaline refracting mausoleum they have no special beauty. A mass of soft glass sufficient for the lower half of such a letter weight is now prepared, and upon its hot surface the colored floret or ornament is applied, while immediately another workman approaches with a second hemispherical mass of colorless glass which he applies upon the upper surface of the ornament. Thus one compound mass is produced having the ornamental glass in its centre, and after being duly fashioned, and annealed, and cut, forms the wonder which we see.

We have already described the mode in which the surface of the Bohemian crystal is flashed over with a film of ruby or other colored glass. It will be readily understood that the cutting away of a part of the colored surface will leave the colorless ground in bold contrast. The engraving of glass is a distinct art, and requires the same kind of skill as that requisite for the production of cameos and intaglios, which was so well understood by the ancients. Very good diagrams of the processes of glass grinding and engraving will be found in Knapp's Applied Chemistry, Vol. II., article Glass, from which we have made large drafts already.

Among the curious things of ancient Egyptian art in the collection of Dr. Abbott, so long on view in New-York, was a glass ornament with a chromatic interior floret resembling so nearly the Venetian letter weight of modern times as to leave no doubt (granting the genuineness of the object) that all the processes of the modern glass house were then in use.

Glass beads have been made from very ancient times in Venice where the art is still practised. It will readily be understood that the variously colored rods already described may be as easily formed tubular as solid. One of the peculiarities of glass is, when heated, to round itself on the sharp edges. When beads are to be formed, colored tubes of glass drawn down to the proper diameter are cut up into pieces of the proper length, and a large number of these are cautiously heated, when their edges contract and become rounded into the form of beads. This operation is performed in a revolving cylinder of iron, in which the glass fragments are tumbled about by the revolutions of the cylinder, mingled with dry lime and charcoal, to prevent them from agglomerating when softened. A fine collection of the Venetian beads, mosaic glass enamels (*millefiori*) and aventurine, may be seen in the Austrian court. The Venetian Aventurine owes its spangles of gold color to the presence of small particles of sub-oxyd of copper (or as some chemists say, of metallic copper), in an opaque ground. Among the modern uses of glass which are most promising of future usefulness are the adaptation of large and strong pipes or tubes of glass for the conveyance of water and other fluids; and also casting of rough plates of strong cheap glass for roofs and floors of buildings. As glass is, in reality, one of the cheapest of manufactured products, and also one of the strongest, when formed of the more common materials, and when used for conveying fluids its color is a matter of no moment, it is easy to believe it may easily take the place of lead in conveying water, and thus avoid all the risk of injury to health which is confessedly inseparable from the use of that metal.

Optical Glass.—The demands of physical science have not been easily met by the glass maker, who, until a very recent period, has been unable to supply with any certainty even moderately large masses of faultless glass. To be *faultless* for optical purposes, glass must have a uniform density, a high refracting power (if flint glass) colorlessness, freedom from striæ, and lastly, an absence of air bubbles. To meet these requirements has staggered the resources of the whole scientific world, who have by the most able commissions investigated this subject with the greatest care both in England, France and Germany. For some time Fraunhofer was believed to be the only person who, by a process secret with himself, could make large lenses for refracting telescopes free from striæ and other imperfections. This was early in the present century, and long before Faraday had made his celebrated researches as head of the Commission of the Royal Society for investigating the subject. We will not repeat the history of this interesting subject, which has been so often discussed, and may be found in all the standard works. Suffice it to say, the difficulty has been overcome, and glass discs of any required dimensions may now be made with considerable degree of certainty that they will be free from serious imperfections. The difficulties which so long stood in the way of perfecting this branch of the glass maker's art, were chiefly, the existence of striæ from inequalities of density in different parts of the mass, the presence of air bubbles, which were given off in a late stage of the process of fusion, and the deterioration of color from the implements and means employed in stirring. Guinard, a pupil of Frauenhofer, introduced the practice of stirring the molten mass in the pot by means of a stirrer composed of the same materials as the pot itself, in place of an iron rod before used. This simple expedient, combined with great skill, especially in the construction of his furnace, and in the process of annealing, has enabled M. Bontemps to produce and exhibit in London in 1851, a disc of faultless flint glass of 29 inches diameter, and weighing over 200 pounds. The jury of Class V. have in the Jury Reports rendered a most interesting account of this remarkable flint glass disc, which was ground and finished in such a manner that it could be submitted to all the most searching optical tests, not omitting the use of polarized light. When we remember that the joint efforts of Frauenhofer and Utzschneider of Munich produced only lenses of 9 inches diameter, and that in 1828 M. Bontemps was regarded as having produced a true marvel of optical art in turning out a lens of 14 inches diameter, it will readily be understood that the late achievements of the same gentleman in the well known establishment of Messrs. Clance, Brothers & Co., in Birmingham (where he is now permanently connected), should have received the unqualified approval of such men as Sir David Brewster, Sir John Herschel, Lord Wrothesley, Prof. Miller, Mr. Simms, and Mr. Ross. The density of this mass was 3.56 to 3.58, and its thickness about 2¼ inches. The composition of Bontemps' flint glass is 200 lbs. of pure sand, as much pure minium, and 60 lbs. of calcined soda. The metal is stirred during thirty-three hours, and until the stirrer is moved with difficulty. The furnace is then closed, and suffered to cool for about eight days, when the cold mass of glass is broken out of the pot and its opposite faces ground to determine its quality. Subsequently it is cut up into discs of such size as may be required, which are then softened by heat and pressed in a mould into the rough form of the future lens. This can be accomplished without injury to the glass. M. Bontemps offered, some time since, to the French Institute, through M. Arago, to furnish lenses for a telescope 22 inches in diameter, at the following rates :—

	Francs.	Dollars.
Flint glass disc 22 inches in diameter, and weighing 80 pounds, at 5 francs per lb.,	400	80
Softening and moulding the mass,	140	28
	540	108
Crown glass disc, weighing 50 lbs., at 5 francs per pound,	250	50
Softening and moulding,	200	40
	450	90

Such a flint glass disc as the above would at former rates have cost more than twenty-two times as much, or about $8000, and, if furnished at all, would have been in all probabilty of inferior quality. The chief cost of refracting telescopes has formerly been in the object glasses. The Cambridge object glass (one of the largest in use) is about 16 inches in diameter, and its cost is understood to have been about $15,000, the whole instrument costing about $25,000. It seems reasonable to hope that hereafter refracting telescopes of larger size may be finished at a greatly reduced cost, although we must remember that the process of grinding, and of giving an exact figure to the lenses, still remains a great and difficult work.

Very few specimens of optical glass are seen in the present Exhibition, and none of remarkable size. See Nos. 12 and 19, Class 10.

Artificial Gems.—The visitor at the Crystal Palace must have noticed in the Austrian Court the collection of artificial gems shown by A. Pazelt, of Tuman, Bohemia (No. 2, Class 24, Austria). These *pastes*, as they are usually called, rival in color and lustre the natural gems, and are in fact inferior to them only in hardness (except the diamond whose adamantine lustre cannot be imitated). The material from which these artificial gems are made is a very colorless and limpid flint glass, called *strass*, after its inventor. Its peculiar limpidity and lustre is due not so much to the great quantity of lead it contains as to a portion of the silica being replaced by boracic acid. Its composition according to Wieland is:—

	No. 1.	No. 2.	No. 3.
Ground rock crystal,	100	——	100
Sand.	——	100	——
Pure minium,	156	——	154
White lead,	——	171	——
Purified caustic potash,	54	32	56
Boracic acid, or its equivalent of borax,	7	9	6
Arsenious acid,	½	½	½

The colorless limpid glass thus obtained is the basis of all the artificial glass gems, and may be colored by the metallic oxyd already noticed. Thus *topaz* is imitated with glass of antimony and purple of cassius or oxyd of iron; *ruby* with purple of cassius; *emerald* with oxyd of copper or chromium; *sapphire* with oxyd of cobalt; *garnet* with purple of cassius, glass of antimony and peroxyd of manganese, and so on.

The principles of glass painting have already been discussed in an article to which the reader is referred.

BANK-NOTE ENGRAVING.

THE specimens of this art in the Picture Gallery have excited the admiration of every visitor who has given them a careful examination. Nothing is rendered more familiar to us by habitual use than a bank-note; yet, of the thousands who handle them daily, there are very few who bestow even a passing glance upon their vignettes and other designs, or who are acquainted with the mode of their production. In truth, the value of a bank-note as the representative of the precious metals, takes away all idea of its worth as a work of art, and yet in this latter respect it is entitled to notice. Not only has this branch of engraving been carried to the highest perfection, but it is interesting to us to consider that this perfection is due exclusively to American invention.

The prevention of forgery in bank-notes, bonds, certificates, and similar promissory paper, is chiefly due to the costly style of their execution. If the very best artists are employed in drawing the designs, and the best engravers in executing them, forgery becomes not only difficult, but unprofitable—a bank-note plate at the cost of one thousand dollars is much less likely to be imitated than one that costs one hundred. And this consideration, evidently a correct one, has furnished one example of the valuable alliance between business and art which is common in highly refined communities; though it must be confessed that in this case the union is not due to taste only. But whether due to taste or economy, the result is the same, and the lover of art will find his curiosity amply repaid if he will study the beautiful specimens of bank-note engraving in the picture gallery, exhibited by Messrs. Rawdon, Wright, Hatch & Co., 48 Exchange Place, New-York city, and by Danforth, Wright & Co., also of New-York.

The present style of bank-note engraving originated in the discovery, by our ingenious countryman Mr. Jacob Perkins, of the method of engraving on steel which gives to the productions of this art a durability never before known. By means of this method the works of the artist may be reproduced and multiplied indefinitely. A steel plate properly prepared is engraved or etched in the usual way. A cylinder of very soft steel, of from two to three inches in diameter, is made to roll forwards and backwards on the surface of the steel plate, which in the mean time has been hardened, until the impression of the engraving is seen upon the cylinder in alto relievo. The cylinder is then hardened, and is rolled in the same manner upon the surface of a copper or soft steel plate; the result is a perfect copy of the original plate. This style of engraving is very economical where a great, or an indefinite number of impressions are to be used—more than half a million of impressions have been printed from a well-hardened steel plate, while a copper plate is deteriorated by printing six thousand impressions. A hardened steel plate will in fact print more *proof* impressions than six copper plates will give common impressions. At the very lowest estimate, the relative values of the two kinds of engraving are as one to four, apart from the consideration that of the copper plate impressions many are imperfect. On the other hand, it must be remembered that this method of engraving is only employed where a number of impressions is required sufficient to wear out three copper plates; a less number would not warrant the cost of making a steel plate. From this it appears that much the largest proportion of the plates now in use must be of copper. The art of steel engraving is very extensively applied to the embellishment of standard works, and to the illustration of books of instruction and science. But, to return to bank-note engraving; besides the medallions and vignettes on the notes, there are other forms of engraving consisting of a variety of circular, oval, and rectilineal shapes, exceedingly variegated and interlaid, and exhibiting a most curious, beautiful, and symmetrical intermingling of geometrical figures. All these are produced by an ingenious and remarkable machine invented by our countryman Mr. Asa Spencer. This machine has been justly compared, in its power of presenting an infinite diversity of patterns, to the far-famed scientific toy, the kaleidoscope. It possesses this peculiarity of the kaleidoscope, that the turning of a screw, like a change in the position of Sir David Brewster's instrument, gives rise to an entirely new pattern, such as has never been seen before, and may never recur again. This pattern, however, may be preserved and perpetuated by the transferring process. The forms produced by this machine, which is called the geometrical lathe, will be found on inspection to contain an intricate and mazy concretion of lines and dots, which to the practised eye constitutes the best practicable means of identification. And to these forms is given the effect of a beautiful combination of copper-plate and letter-press printing, by making the lines which in one scroll or block are white, in the next black, and so alternating through the whole series, in which the figures themselves are, except in the shading, precisely alike. It is worth mentioning, as an example of the illiberal jealousy which merit has often to encounter, that Sir William Congreve employed an artist of the first talents to attempt an imitation of some of the specimens exhibited by Mr. Perkins in England in 1820, when he was endeavoring to bring his invention into use. The attempt was pronounced by his own countrymen a total failure, particularly in the small writing and engine work; though Sir William maintained the opposite opinion, and published a pamphlet for the purpose of impressing this opinion on the public. This "Record" which has for its high object to promote the knowledge and diffusion of art among the nations, and to remove those narrow national prejudices which have interfered with such diffusion, is the proper place for holding up to public rebuke the conduct of Sir William Congreve.

In the making of plates, cylinders, circular or other dies, the best cast steel is used. For the purpose of transferring fine and delicate engravings, a surface stratum of the steel plate or cylinder, descending to about three times the depth of the engraving, is decarbonated, by which it is softened and rendered fit either for transferring or engraving designs. This is a process demanding great expertness. After any piece of steel has been decarbonated, whether a plate, or cylinder, or die, it must, previously to being put under the press, be again carbonated, or reconverted into steel capable of being hardened. This carbonization, or reconversion into steel, is effected by means of animal carbon. Here again is a process which can only be safely attempted by the most experienced workmen. It would be impossible to describe by words only, the two criteria of color and sound on which the successful execution of this delicate task depends. They are only to be learned by actual observation. They are among the mysteries of art. Before concluding this brief notice, we will venture once more to ask the curious in the fine arts to look at the vignettes on the specimens of bank-note engraving in the gallery of paintings in the Crystal Palace, however familiar they may seem to him. He may be surprised to discover in them some unexpected beauties. He will not only admire their correctness in perspective, in drawing, and in shading, but also the rare finish of their engraving. He will derive pleasure, moreover, from the varied and ingenious representations of the pursuits of industry on the land and on the ocean; and may be led into an agreeable train of thought by contemplating the pictorial views of that labor and art which supply

"The fireside enjoyments, home-born happiness,"

of many millions of free and happy people on both sides of the Atlantic.

The fine silver CENTRE PIECE, of which we here give an illustration, is exhibited by Mr. J. ANGELL, of the Strand, London. The scene and the characters are thoroughly and characteristically English, and both are familiar as household words to every reader of English literature. The precious metal is not too precious to give visible form to a scene in which Sir Roger de Coverley figures, that exquisite creation of the inventive genius of Steele and Addison's refined taste, which embodies all our no-

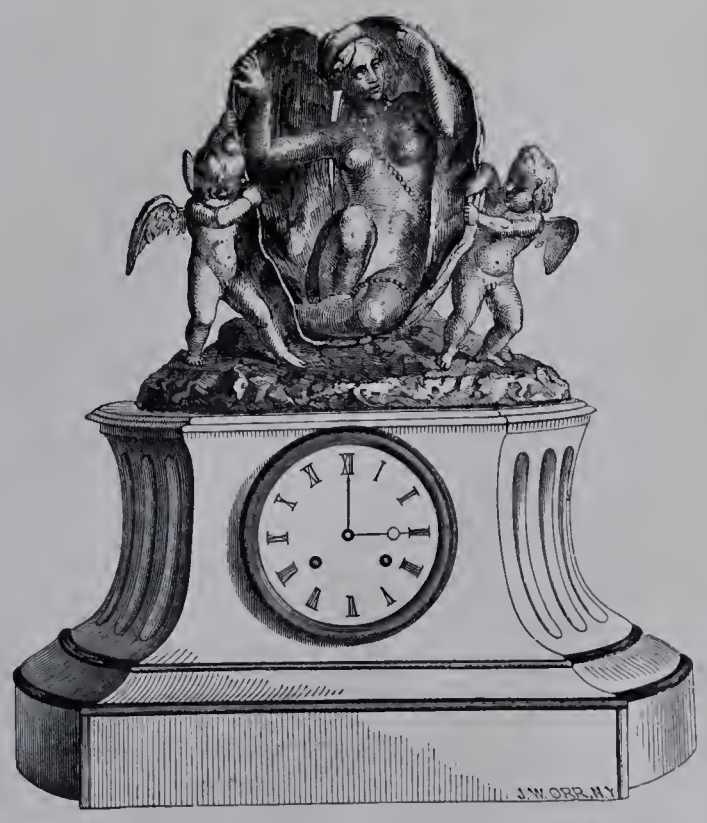
tions of the character of the old English gentleman. The story of the interview is told with humor in the Spectator of July 30th, 1711. The good knight, the principal figure in the foreground, has just alighted from his horse, and exposes his palm to two or three of the gypsies, who crumple it into all shapes, and diligently scan every wrinkle that can be made in it, while one unfolds her cabalis-

tic art, and over every barrier of prejudice wins her way to the heart of Sir Roger, by her apt allusions to his suit to the coy and fascinating widow, whose personal charms and mental graces the Spectator has drawn with as nice a discrimination as appears in the Coverley portrait. The figure in the background is Addison himself, surveying the scene, which his pen was to make immortal.

The GAS BRACKET is exhibited by Messrs. CORNELIUS, BAKER & Co., of Philadelphia. This bracket has four lights, though only two are given in our engraving. The bronze is heavily gilt, and the ornamentation, both in style and workmanship, is excellent and beautiful, and unexceptionably appropriate to the object.

A beautiful and highly meritorious example of American manufacture in the precious metals—a branch of art-manufacture only just now rising to commercial importance in this country—is seen in the SALT CELLAR, placed at the head of this column. It is silver

gilt, and pierced to show the rich color of the ruby glass lining. Mr. J. T. AMES, Chicopee, Mass., is the manufacturer and exhibitor of this, and also of the silver gilt WINE COOLER which comes next in order.



The ornamental bronze CLOCK is exhibited by MM. DUPLAN & SALLES, of Paris. In the group of figures Venus is represented emerging from a sea-shell, and two cupids aiding her.

We continue our illustrations of the goods of Messrs. Cornelius, Baker & Co, with two subjects engraved upon this page. The Chandelier is very rich and beautiful, suited to adorn as well as illuminate the apartment in which it may be hung. The

bronze of which it is made has a tint of rich, deep green, which is relieved with admirable effect by the brilliancy of the gilding applied to the decorative parts. The

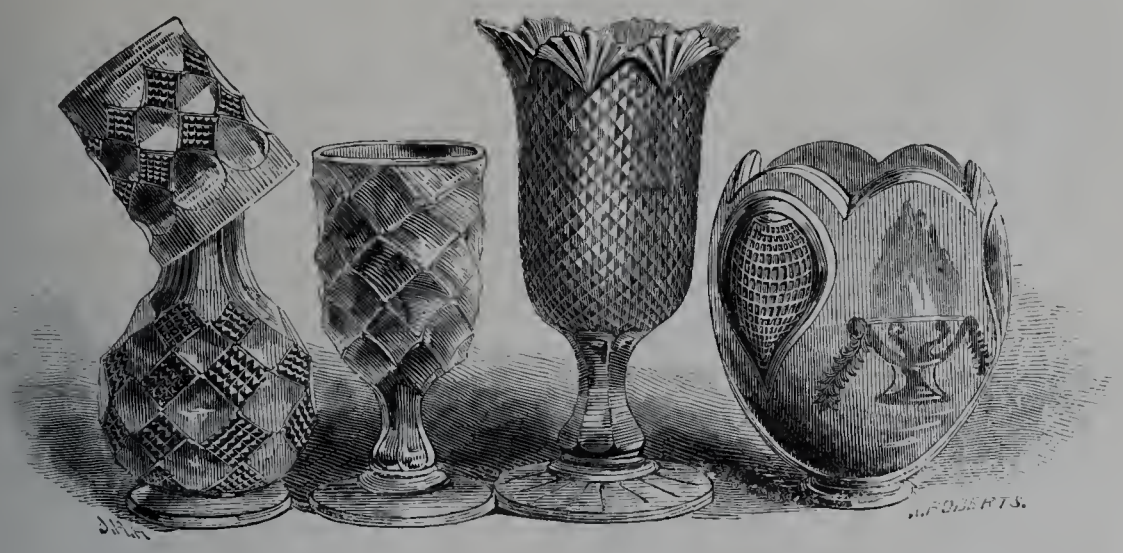
adjoining Bracket with a pendent chandelier of four lights is also characterised by eleganee of form and ornamentation, exeepting, however, the little figures perched just above the branches of the lights. These have no adaptation to a chandelier, and violate a fundamental law of deeorative art, that all ornamentation should rise out of construction and belong to it.

The remaining engravings illustrate an Ornamental Table, exhibited in the Swiss

Department, by J. Wirtz, of Berne. The material is a very light-colored wood, and the carvings are exeeuted with delicacy and spirit. It was not, however, to display the carving, but to point out the errors eommitted in the decoration, that we have had this article engraved. In furniture of every kind the first consideration of the

designer should be to adapt it perfectly to its intended use. While this rule admits of no exception, its observance will be found to be the safest guide to beauty. There are many objects in the Exhibition richly and lavishly decorated, which nevertheless

fail to please the visitor, who, if critically educated, will at once refer this effect to its proper cause—the violation of the principle just stated. The Swiss table is such an instance of this pointed disregard of use and its consequent want of beauty. Nothing can be more obvious than that the top of a table should have a perfectly smooth and level surface; whatever ornaments are employed here must be inlaid. But the delicate floral decorations in this example are carved in high relief, always liable to be defaced, and only make the toy useless, which they were designed to make beautiful. Besides, there is no repose in the work. One part is as fully decorated as another. It bristles all over with carvings, which are spoilt by the want of contrast, and lose their beauty in its own excess. The rightly educated decorative artist understands the value of simplicity, and that good taste is shown quite as frequently by the absence as the presence of ornament. Above all, he will avoid constructing decoration; but having first constructed, he will then decorate his work, with ornaments such as a refined taste and judicious study of nature teach him to be appropriate in style and number and therefore to be beautiful.



Messrs. Joseph Stouvenel & Co., of New-York, exhibit a great variety of glass ware, both pressed and cut, from their manufactory. These specimens are made of a clear and beautiful glass, and display a high degree of skill in the manufacture.

A rich Brocade Poplin of pink and white, and made with silver tissue, is manufactured by Messrs. Clabburn, Norwich, England, exclusively for the firm of A. T. Stewart & Co., of New-York, by whom it is exhibited. The pattern is composed of leaves, flowers and grape very tastefully grouped and wreathed together.

Two Lamps exhibited by Lerolle Freres, are of a high order of merit. The female figures which support the lamps are modelled with artistic

skill, and exhibit a beauty of workmanship which is almost characteristic of the bronzes contributed by this firm.

Below is a Centre Piece, which is now filled with flowers, but may be converted into a candelabrum at the pleasure of the owner. The figure is bronze, but the remainder of the piece is heavily gilt.

The ornamental Clock Case is contributed by M.M. Duplan & Salles, manufacturers of artistic bronzes, Rue de Bondy, Paris. The case is surmounted by a figure of Contemplation, sitting in the attitude of profound thought.

The Vase which follows is executed in terra cotta, and is exhibited by Messrs. Ferguson, Miller & Co., of Heathfield, Scotland. The ornaments upon this vase are designed in the style of the antique.

We present our readers with another of the beautiful Berlin zinc castings executed by Geiss. This statue is named the Basket Carrier.

The bronze Vase on the opposite page, with a pedestal of black marble, is exhibited by the manufacturer, Augustus Weygand, of Paris.

The same exhibitor contributes the ornamental Clock. This is a combination of porcelain and gilt bronze work. Instead of a dial, the hours are

marked on a porcelain revolving vase, and the time is indicated by a serpent's tongue.

The three ornmental Vases executed in bronze, which adorn the top of this page, come from the establishment of MM. Villemsens & Co., Rue de Temple, Paris. This

firm are extensive manufactures of artistic bronzes and church ornaments, and have acquired a deservedly high reputation, which is fully sustained by the exquisite de-

cacy and beauty of workmanship lavished upon these vases. The art which they display has made them richer and more valuable than many works in the precious metals which might be named. They furnish a most

convincing demonstration of the superior importance of art to mere wealth as conferring value. The vase on

the left has been covered with a surface of oxydised silver.

The designs, we believe, of all these vases, are from the works of Benvenuto Cellini, the unsurpassed master of the art of designing and working the precious metals. They have been rendered with so much completeness

and fidelity by the skill of our engraver, that a detailed explanation is unnecessary.

The Candelabrum in bronze and partly gilt, is also contributed by Villemsens & Co. Its principal decora-

tion is formed by a trophy of arms and armor, and the branches are modelled after dolphins.

In our own Crystal Palace, as in that in Hyde Park, the French exhibitors of bronzes greatly excel all others in the number and variety, as well as in the artistic merit of their contributions, although in regard to this last particular, single articles may be selected for which a comparison with the French bronzes need not be shunned. To

the exquisite works from Paris already illustrated in this part of the RECORD, we add two groups which may be found among the goods of AUGUSTE WEYGAND, Rue Ville du Temple, Paris. The first represents two WILD HORSES playing together; the other is an ARAB IN AMBUSH, and faithfully delineates the craft and stealthy character of the wild son of the desert, while watching for his enemy or waiting the chance of plunder.

We engrave another of the examples of ornamental furniture placed in the American Department of the Exhibition. This piece is a BLACKWALNUT SIDEBOARD,

contributed from the manufactory of ALEXANDER ROUX, New-York. The material is one admirably adapted to display the skill of the cabinet-maker and the carver, and

the size is not too large for the use and style of moderately wealthy families. Mirrors are inserted in the oblong panels of the upright portion. The carving, which

is not profuse, is in the imitative style, and reproduces game and fish and clusters of flowers in the usual manner. The high relief of the groups in the panels is objectionable, if for no other reason, as rendering the carving liable to accident and damage.

The group called the DYING HERON, which adorns this page, is exhibited by MM. DUPLAN & SALLES, the eminent manufacturers of artistic bronzes, Rue de Bondy, Paris. This is one of the most remarkable works of art in the Exhibition. In it the talent of the artist and the skill of the workman are equally conspicuous. It renders a scene from nature with a vividness which produce painful sensations, mingled with our admiration of the artistic power it displays. As one stands before the mute and motionless bronze, he seems to hear the shrill, piercing scream, and see the convulsive struggles with which the heron, struck through with the arrow, yields its reluctant life.

A work quite different from this, but not less worthy of attention for the beauty and appropriateness of the design and the wonderful perfection and delicacy of the casting, is the BAPTISMAL FONT, which is exhibited by the ROYAL IRON FOUNDRY OF BERLIN, through the agency of the Prussian Consul. The figures which stand upon the pedestal, the bas-reliefs of the panels, and the ornamental work, are conceived and executed in the happiest style of art. Like the other Berlin iron castings, it has a bronze surface to guard against rust, and it is lined with brass.

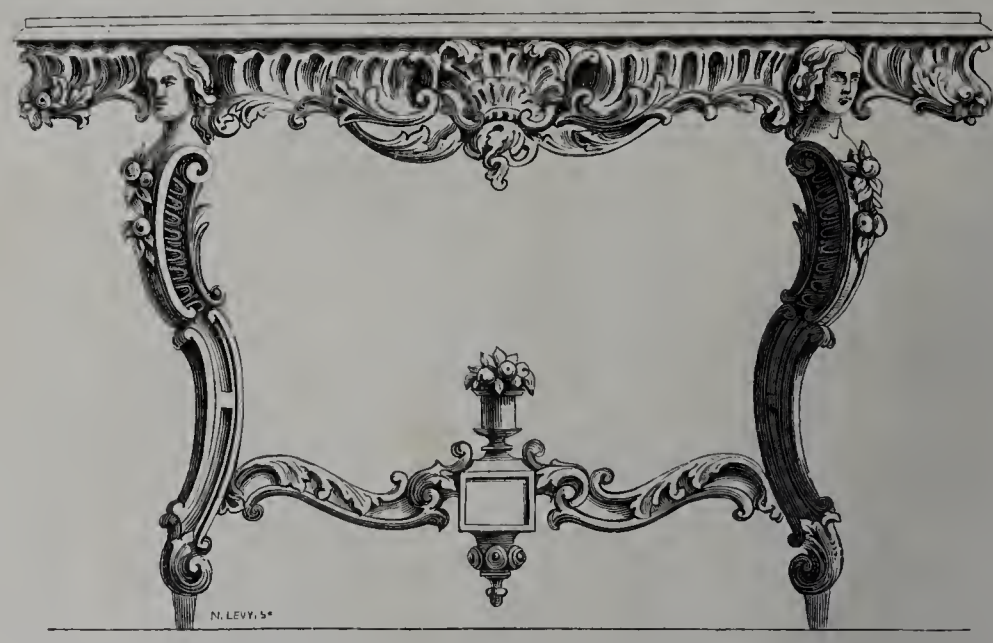
The group in plaster which concludes the page is

exhibited by M. AUGUSTE LECHESNE, a French sculptor. It is named the EAGLE AND CHILD, and represents the attempt of an eagle to carry off a child, while the mother lies in a profound sleep, unconscious of the danger that threatens her defenceless offspring. It is a work of decided merit and power.

The AMES MANUFACTURING COMPANY, Chicopee, Mass., by permission of the United States Government, send to the Exhibition a large collection of the regulation and fancy swords which they manu-

facture for the army and navy. The SWORD which we illustrate on this page belongs to the latter service.

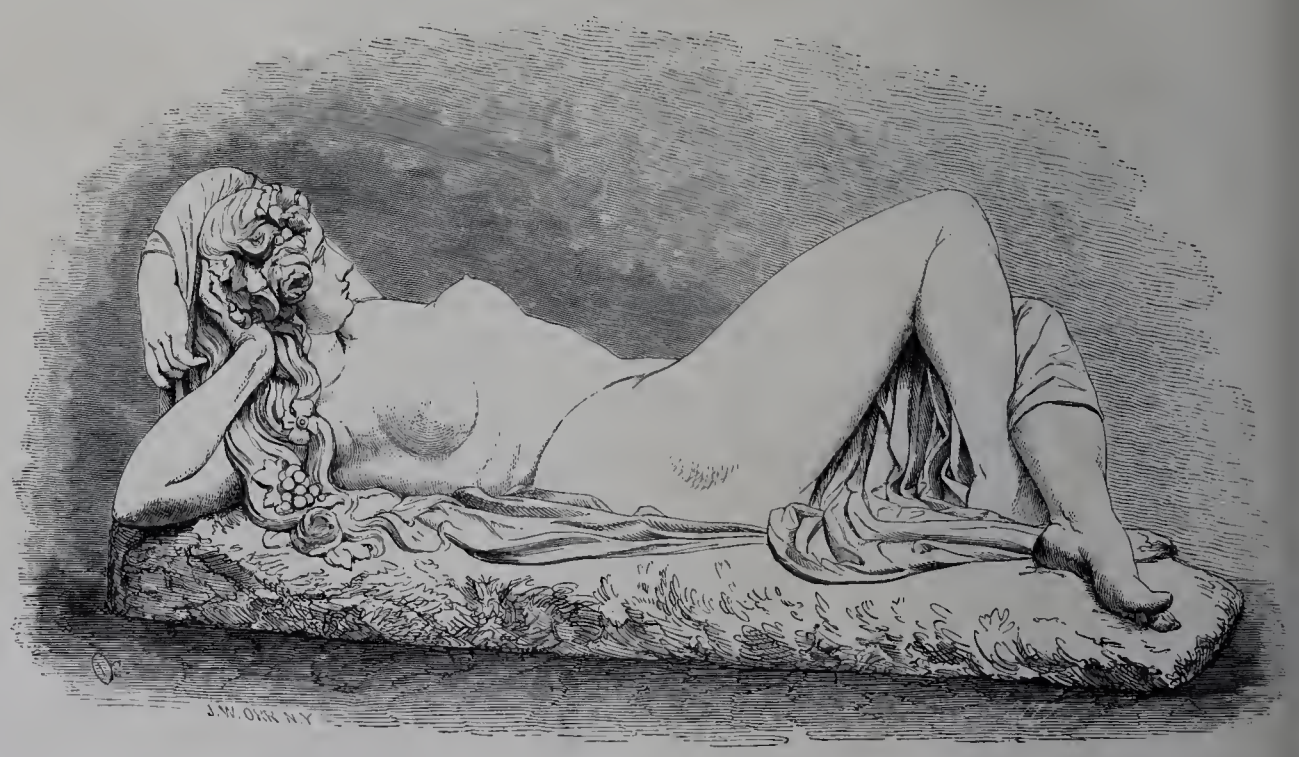
A PIER TABLE, with a richly carved rose-wood frame and white marble top, is exhibited by A. ELIAERS, Cornhill, Boston.



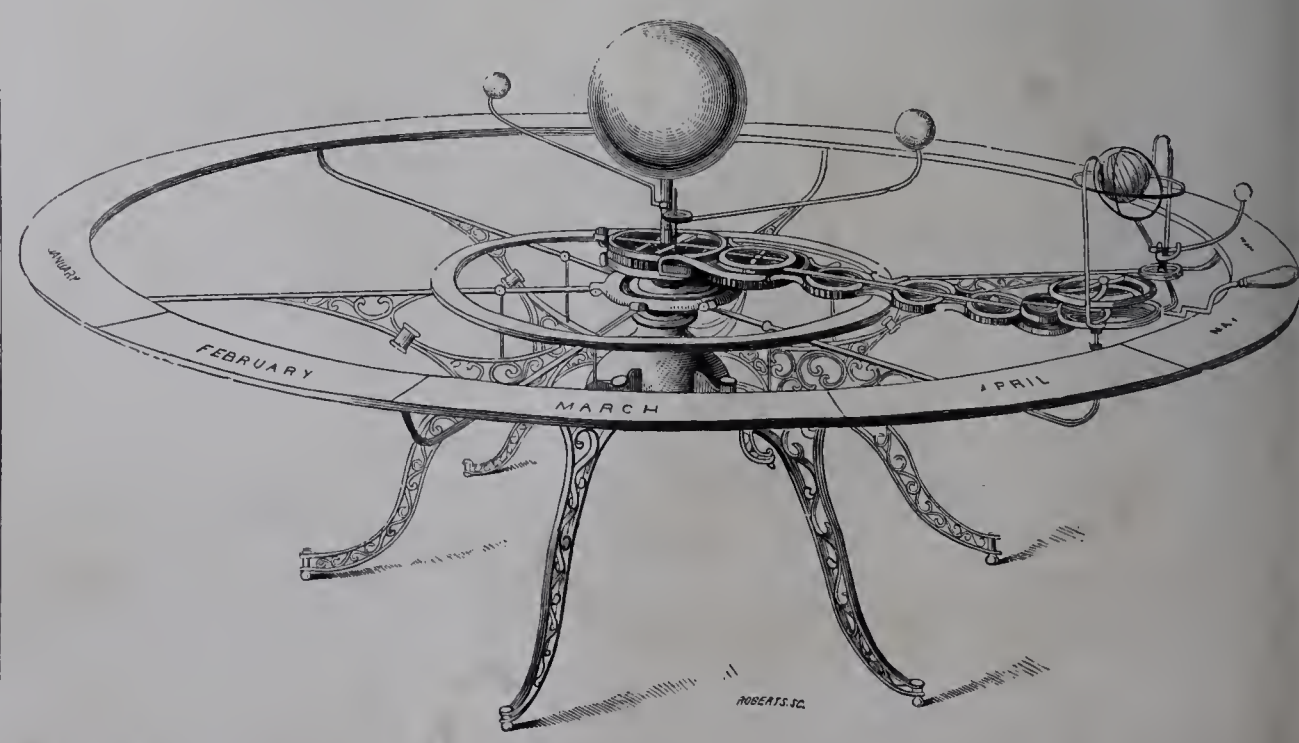
The reclining statue in marble is exhibited by the sculptor, L'EVEQUE, of Paris, and is named by him LESBIA,

but we cannot say whether it commemorates the Lesbia who lives in the mellifluous lyrics of Horace or Moore,

or her who made the despairing leap from the Leucadian cliff.



The concluding illustration represents a very large, complicated, and ingenious piece of mechanism,—the PLANETARIUM, invented and made by THOMAS H. BARLOW, of Lexington, Kentucky. We cannot regard this apparatus as ranking higher than a philosophical toy, and our opinion is confirmed by the high and unimpeachable authority of Sir John Herschel, in his Outlines of Astronomy.

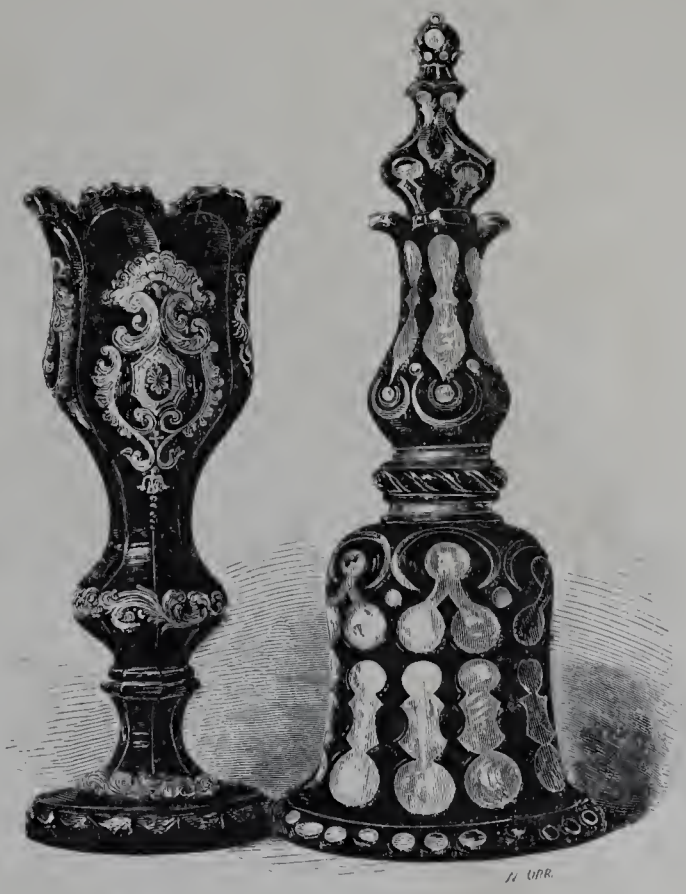


We introduce in the engraving upon the left of this page, two VASES of the beautiful glass manufactured by M. JOSEPH MAES, of Paris. The taller vase is ornamented with stripes of a milky-white, opalescent glass, the color of which is produced by

phosphate of lime or arsenic, the latter producing the finer varieties. The chemical composition of this French ornamental glass differs from that of Bohemia which it so

strongly resembles, in the substitution of oxyd of zinc for oxyd of lead. This change is attended with many advantages. The glass is purer, and less liable to changes of color in manufacture, due to the conversion of the oxyd into metallic lead, and, we believe, can be made at a cheaper rate. M. Maës also exhibits specimens of lenses of perfect transparency.

The adjoining VASE and DECANTER are exhibited by E. STAINER. They are Bohemian ruby glass, and have engraved decorations.



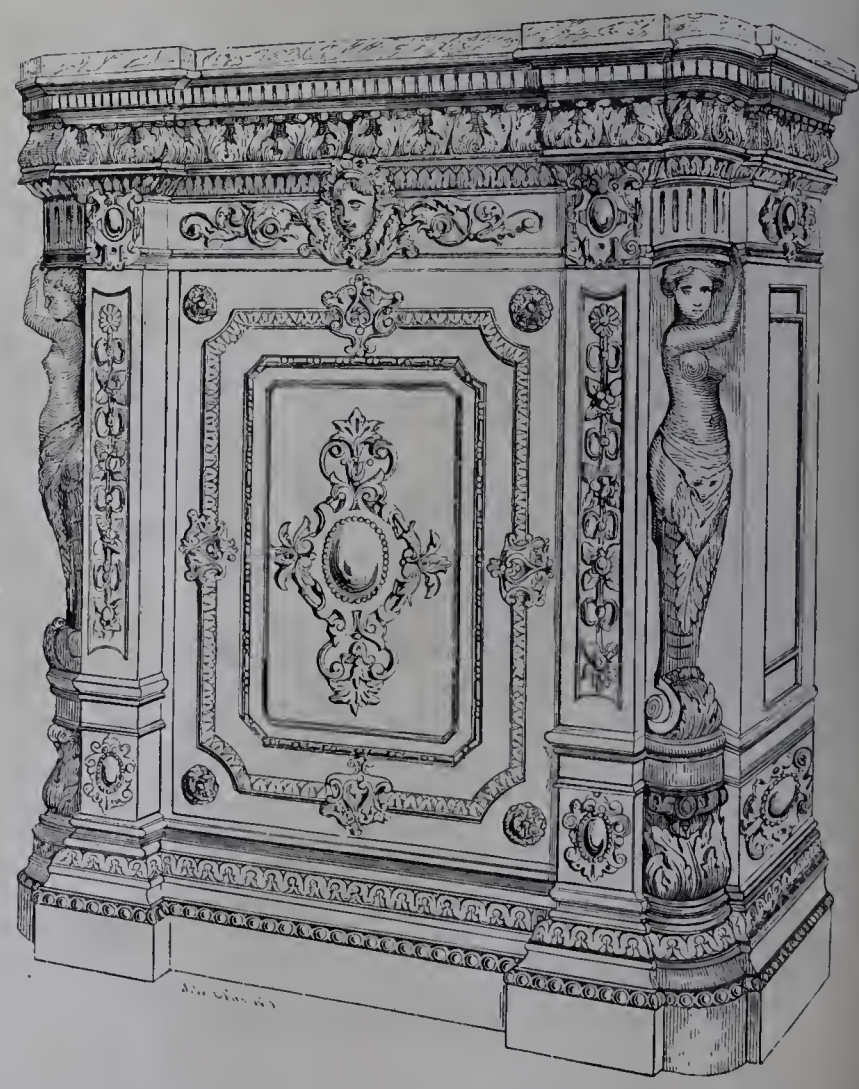
Denmark is represented in the New-York Exhibition only by two groups of sculpture, but one of these is an acknowledged masterpiece of majesty in art—the Christ and the Apostles of Thorwaldsen—and the other is the remarkable group which we here engrave, the ADAM AND EVE, by Prof. JERICHAU, of Copenhagen. The sculptor has chosen the moment of reflection and remorse which followed the fallacious pleasure of disobedience.

The sentiment of the following group in marble is in striking contrast with the

preceding. It represents LOVERS GOING TO THE WELL, and happily expresses the confiding affection and happiness of the affianced pair. It is exhibited by TOMMASO LAZZERINI, of Cararra.

Our first engraving on this page represents, though less completely than we could wish, a MOSAIC PICTURE in wood, exhibited by T. GARASSINO of Savona, Sardinia. The subject of the picture belongs to the mythology of Greece. When Minos, King of Crete, conquered the Athenians, he imposed an annual tribute of seven youths and seven maidens, who were selected by lot from the families of the Athenians, and given up, on their arrival in Crete, to be devoured by the Minotaur, the mythic monster which Minos kept in the Labyrinth. From this cruel tribute Athens was delivered by Theseus, the great legendary hero, and founder of the Attic nationality. On one of the occasions of selecting the victims, such as the picture represents, Theseus voluntarily offered himself as one of the youths, with the design of slaying the Minotaur, and by the aid of Ariadno, his adventure was successful.

The richly carved CHAIR was manufactured by GEO. J. HENKELS, of Philadelphia. The material is an ironwood from Mexico, which admits of fine carving and a high polish The wood once formed part of the fortress of San Juan d'Ulloa, whence it was brought in the rough state by an officer of the American army of occupation under General Scott. The ornaments of the chair are heraldic, and consist of the weapons and armor of various ages, around which the acorn and olive branches are



gracefully disposed. The American shield and eagle have not been neglected. It is upholstered with green goat-skin. The name of the French artist who executed the carving we have not ascertained.

Messrs. Morant & Boyd, of London, exhibit a Cabinet which the foregoing illustration represents. The surface is enamelled, and the decorative portions are gilt.

The large engraving which fills this page represents one of the patent Axminster Carpets, from the extensive manufactory of Messrs. James Templeton & Co., of Glasgow. These carpets are woven on the loom, and not tufted to the warp as was formerly done; in this way the worsted is thrown on one side, and a smoother surface is obtained.

The decoration invites a brief comment upon its character. It will be seen that the carpet is divided into compartments which are surrounded, and in part filled with arabesque scrolls, &c., some of which were invented to ornament furniture, while others were undoubtedly designed for architectural uses—mural ornaments, and carved and gilded cornices. The flowers and fruits which constitute the remainder of the design are direct imitations of nature. Like the scrolls, they seem to stand out in high relief, and to have been strewn upon the surface rather than to form an integral part of it. One is almost afraid to walk here, lest his inadvertent foot should crush the delicate beauty of the roses, or tread out the purple juices of the grapes. We submit that this is not appropriate. Good taste forbids the confused and indiscriminate intermingling of the ornaments of different arts. We do not strew bouquets or pile fruit upon our parlor floors to decorate them, nor should we find it convenient to walk over bronze scrolls, or carved panels and mouldings; and common sense should teach that the pictures of these things are in the same places equally inappropriate. Indeed the impropriety increases as the imitation becomes more deceptive and exact. Both makers and buyers of carpets may profitably refer to the practice of those eastern countries where carpets had their origin. There a strict mosaic principle prevails throughout, and no fac-simile or relievo ornaments being employed, the carpet is smooth and flat in appearance as well as in reality. Turks, Persians, and Hindoos, are commonly classed among barbarous, or at least half-civilised nations, but in the matter of decorating carpets they exhibit a refined taste and correct perception of the fitness of things, such as is rarely seen in the manufactures of Europe.

We introduce upon this page an illustration of the truly magnificent Buffet, exhibited by Messrs. Bulkley & Herter, of New-York. The designs for the decorations were made by Mr. Herter, and were executed by Mr. E. Plassman; and the construction was carried on under the joint direction of these gentlemen. The material employed is American oak, which, in color and every other artistic requirement, is seen in this work to be admirably suited for ornamental furniture.

This excellent production deserves something more than a passing glance of curiosity or admiration. It is one of the most noticeable objects that challenge the attention of the visitor to the Exhibition, and one which will repay a careful study as much as any other among the thousand articles of luxury there displayed. In its own class we regard it, on the whole, as the best specimen of the art it exemplifies. The carving has been executed with masterly skill, with the boldness which the material requires, and with a due regard to the limitations which it imposes. The artist has wisely, we think, refrained from minute finish and prettinesses of detail, such as are proper in other materials, and give their value to *bijoux*. The design produces its good effect by its general harmony and consistency. Every part fits with every other, and is adapted thoroughly to the uses for which a highly ornamental sideboard is designed. The ornaments are not only excellent and meritorious in themselves, but they have a characteristic significance in their application. They consist of representations of game and fruits, which are disposed with judicious taste, and are relieved with decorations cut in geometric forms. The good effect of these is seen in the panelling behind the centre-piece, satisfying the natural expectation of the spectator, but not withdrawing his attention by a distracting variety of accessories from the artist's masterpiece. This central group representing the Death of the Stag, is designed and carved with great vigor and truthfulness. The production of the more important ornamental portions of the buffet, upon an enlarged scale, renders a detailed description of them unnecessary.

The tendency of civilisation is always from plainness to ornament. The articles of convenience of one age become objects of luxury in the next, and human ingenuity is taxed to decorate the common necessaries of life. To trace the successive steps by which the rude blocks of wood and roughly hewn planks that constituted the furniture of the earliest times, have assumed the elegant and decorated forms of civilised periods, is

one of the most instructive and amusing branches of historical inquiry. The wealth, the manners, the refinement, all that relates to the social condition of a people, may be deduced from the history of their furniture. The condition of commerce, and of the industrial and fine arts, is contained in such a history, and in this point of view, the mutations of furniture are as important to be known as the changes of governments.

The buffet may thus be taken to mark an era in our

social existence—the transition period when the domestic appointments of our fathers are being replaced by the costly and elaborate furniture of Europe. Indeed, the imposing dimensions of the buffet are more in unison with the hereditary magnificence of an English manor-house or an Austrian castle, than with any of our private residences in town or country. And here we may be allowed to remark the prevailing want of correspondence in style between the architecture of a house and its furniture. Undoubtedly they ought to harmonize, and

we find that such a relation has always existed in other countries and in past times. The forms and ornaments of furniture were invariably copied from the architecture of the period, so that the date of the one being ascertained, the other is known also. This fundamental rule, equally sanctioned by usage and by taste, we have forgotten or disregarded. Our edifices, public and private,

are built in styles borrowed without judgment from every age and nation, and are decorated and furnished with a taste quite as cosmopolitan and injudicious. Rooms, crowded with articles, each the most expensive

of its class, may advertise us of the owner's wealth, but they do not satisfy our instinctive love of beauty that comes from harmony and grace. The medley of riches in the show-rooms of a first-class auctioneer is some-

times paralleled in wealthy mansions.

We have often had occasion to remark that the ornamental parts, at least, of articles exhibited in the American Department, were the work of foreigners who have become citizens by adoption. So far as we can ascertain, all the specimens of sculpture in wood worthy of notice are of such origin. While our native mechanics exhibit an unequalled constructive skill and versatility, they are not often gifted by nature with artistic cleverness, and their attempts of this sort are usually far inferior to the productions of European workmen, who, in many cases, have received an artistic education, and always have been surrounded by good models, and stimulated to imitate their excellencies. The mention of the deficiency points out the remedy, and we are confident that our quick-witted artisans will not hesitate to instruct themselves by the examples furnished by the Exhibition.

Messrs. J. Houldsworth & Co., of Manchester, England, exhibit a variety of rich brocades, &c., which are embroidered by machinery. We have selected for illustration upon this page a silk banner embroidered in gold and colors, and a pattern for a

chair worked with gold thread upon a velvet ground. Upon the opposite page we give the design of a border embroidered in gold and colors upon a satin ground.

Embroidery has been peculiarly a handicraft art, one of those elegant occupations to which ladies resorted to employ their leisure hours. But within a few years the ingenious invention of M. Heilman has brought this art also, within the multiplying power of machinery. Heilman's machine enables a single female to manage 80 or 140 needles as easily and accurately as she formerly embroidered with one. A description of this complicated mechanism may be found in Ure's Dictionary of Manufacture.

The engraving which concludes the page, represents a perforated, or openwork

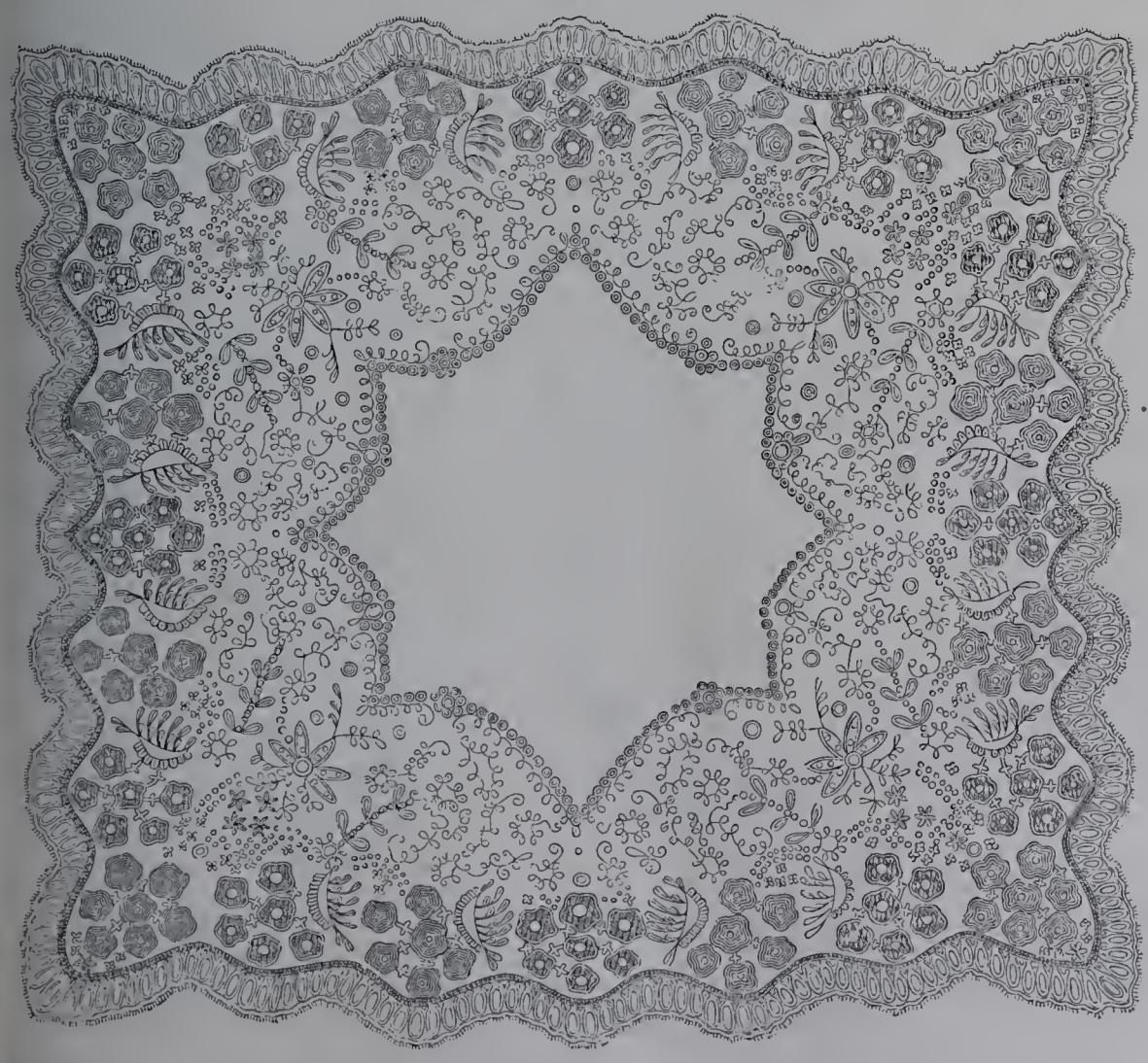
Tazza, from the Royal Berlin Iron Foundry. It exhibits the wonderful delicacy and perfection of casting which are characteristic of the productions of this manufactory.

The small dimensions of the tazza, the complicated nature of its ornaments, and the exquisite sharpness and fidelity of their outlines, indicate an unusual degree of fluidity of

the metal, and unusual skill in the manipulation of it. The cause of the superiority of the Berlin castings is

not open to public inspection. We are informed by an officer of the United States Navy who visited Europe on a Government Scientific Commission, that he was denied admission here, while every other establishment in Berlin was open to him. This tazza also deserves attention

for its artistic merits; in particular, for the skill with which the graceful forms of nature have been modified to satisfy the requirements of decorative art. In this respect it will serve as a useful study to our American readers.



variously referred to peculiar qualities of the iron and to the excellence of the moulds. But whatever the secret may be, it is jealously guarded, and the works are

The Lace Handkerchief, of which we give an illustration, embroidered in lace-stitch, is exhibited by Susan G. Waring, of New Paltz Landing, New-York.

The Caster engraved on this page, is manufactured and exhibited by James T. Ames, Chicopee, Mass. The stand is silver gilt, and the bottles are cut glass. The workmanship of this piece is excellent, and the ornamentation is tasteful and appropriate.

The concluding engraving represents a very elegant

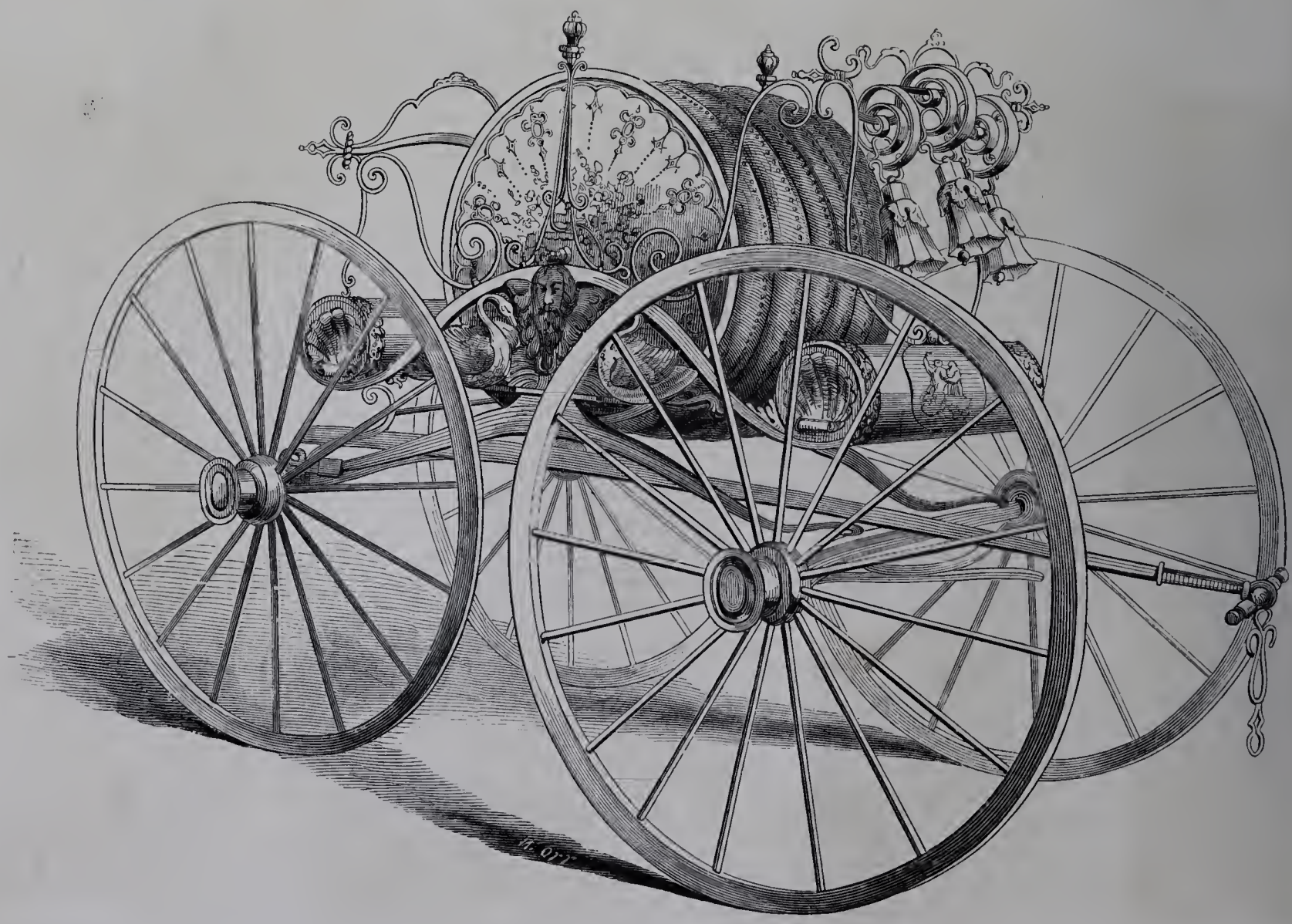
dress Sword exhibited by the Ames Manufacturing Company, of Chicopee, Mass.

This sword was presented by the President of the United States, according to a resolution of Congress, to Brigadier General Worth, for his gallantry and good conduct at the storming of Monterey.

The elegant porcelain VASE, which we here introduce, comes from the ROYAL PORCELAIN MANUFACTORY of Berlin. It is an excellent example both of decoration and form.

The carved zebra-wood CABINET may be found in the English Department. It is exhibited by the manufacturers, Messrs H. & A. ARROWSMITH, of London. The panels contain paintings, covered by plate glass, which represent the different phases of "Woman's History."

Our concluding engraving illustrates the CARRIAGE of the Hope Hose Company, of Philadelphia. This is an elegant and highly ornamental example of the hose carriages in use among our public-spirited firemen. The design was made by Henry McCully. The decorative metallic work is heavily plated with silver, and some portions gilt. Its capability of service is shown by being in active use for three months before it was placed in the Crystal Palace.



Messrs. Jennens & Bettridge, to whose productions we have before referred, exhibit also the Double Chair of papier maché here illustrated. The broad figure represented in the engraving is in gilt.

Hungary. We are informed that the rich and beautiful decorations upon it were wholly modelled by the fingers of the artist. The design represents a triumphal procession of Bacchus, attended by his customary followers.

The Pitcher, executed in a very light colored terra cotta, is contributed by J. W. Kugler, of Güns, in

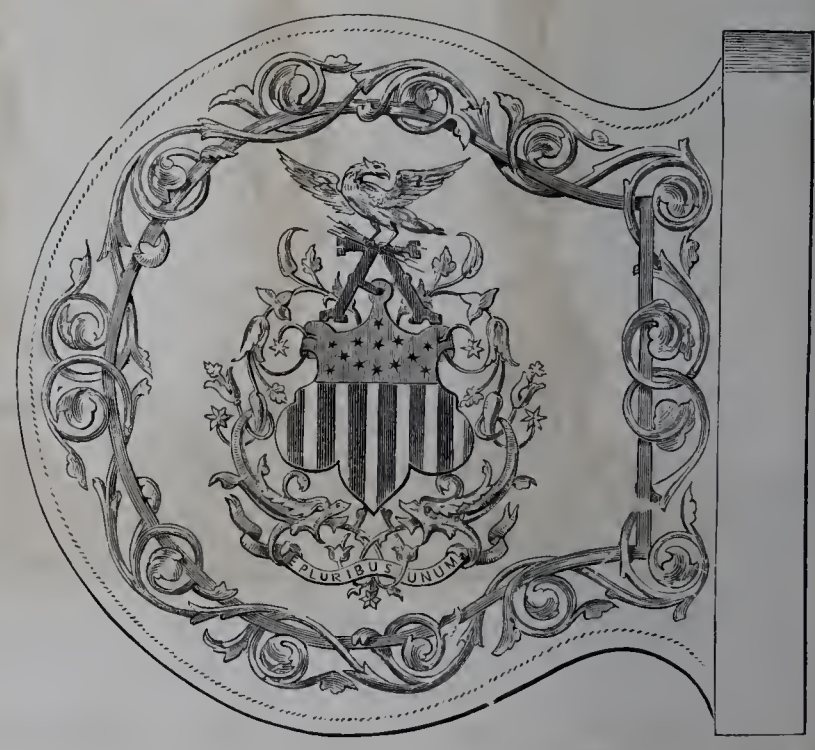
The large Library Bookcase is exhibited by J. Dessoir, of New-York. The material is rosewood, and it is excellently and beautifully finished. The bevelling of the ends, so as to give triangular shelves, does not add to its utility, and the little figures perched upon the spring of the arches of the top, are neither beautiful nor in harmony with the rest of the design. They seem to have been added by an afterthought.

Messrs. J. F. Browne & Co., of New-York and London, exhibit an elegant grand, double action Harp. No commendation of ours can add to the just celebrity which

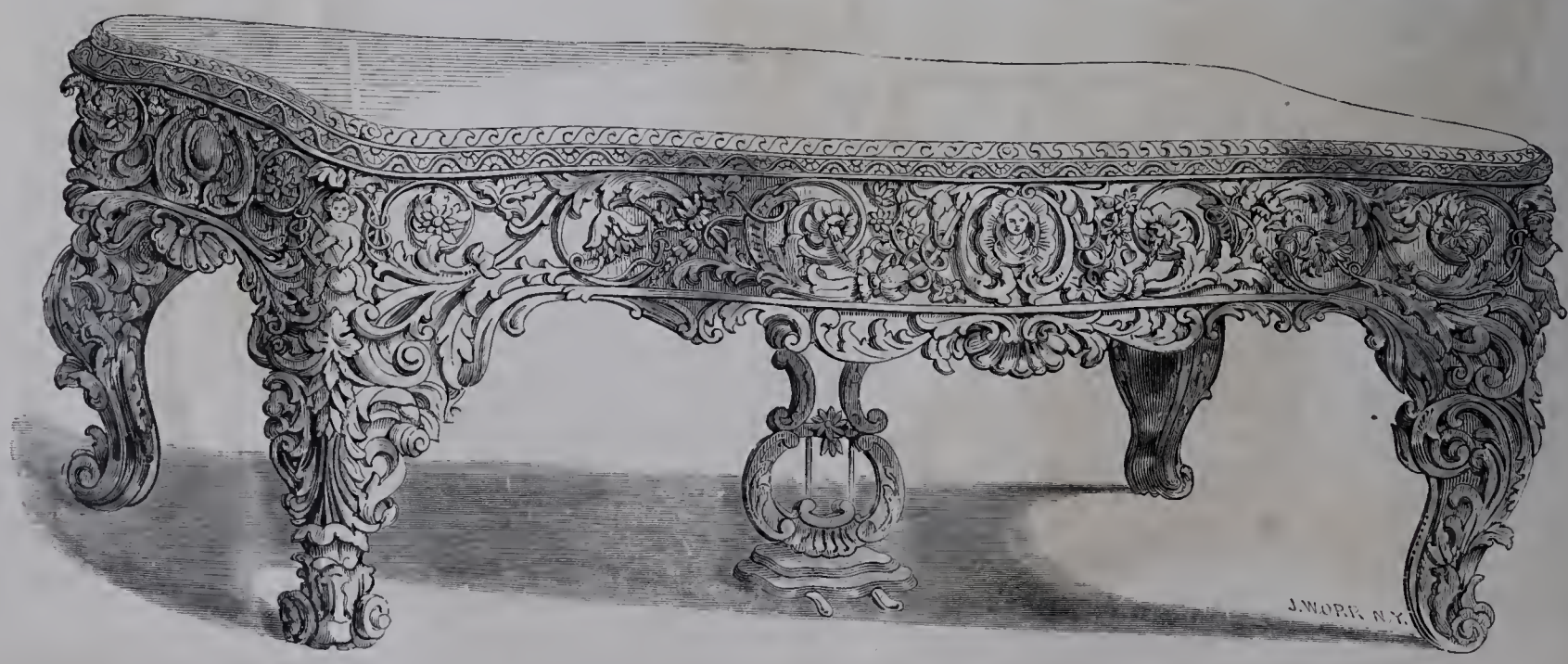
the instruments of these makers enjoy in the musical world, for sweetness, purity and power of tone, and finished workmanship.

Inkstand—is here engraved. The group which adorns the top represents the triumph of Amphitrite.

The following engraving represents part of a Design for a State Harness, which is exhibited by John Penny, of London. The decoration is in plated metal.



A seven octavo Pianoforte is exhibited by S. H. Schomacker & Co., of Philadelphia. The rich carving which covers every part of the rosewood case, loses in part its effect by its very profuseness. It is, however, well executed mechanically.



One of the beautiful works in bronze contributed by MM. Villemsens & Co.—an

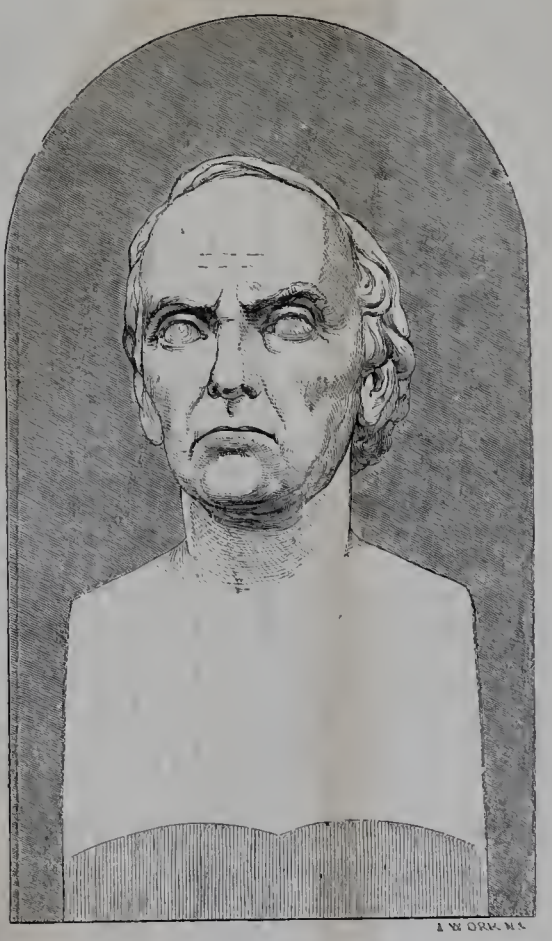
The first illustration on this page represents Church Furniture—a crucifix, and two massive candlesticks—

such as is employed in the ceremonies of the Roman Catholic church. These articles are of bronze, and are exhibited by the manufacturers, MM. Villemsens & Co., of Paris.

We introduce another example of the elaborately carved furniture from the American Department—a Centre Table, manufactured and exhibited by Jules Dessoir, of New-York. The top of the table is in form

an octagon, and has at each angle a caryatide which rises considerably above the top. The alternate ones are prolonged to form the supports. The ornaments of this work in the ricocco style are carved boldly and in high relief, and show a mastery over the art. The material is rosewood, and the top is a slab of white marble.

The Bust of Daniel Webster in marble is the work



of Signor Piatti, the Superintendent of Sculpture in the Exhibition. The features of our country's greatest statesman are faithfully reproduced.

The remaining figure, a model of life size in plaster, is

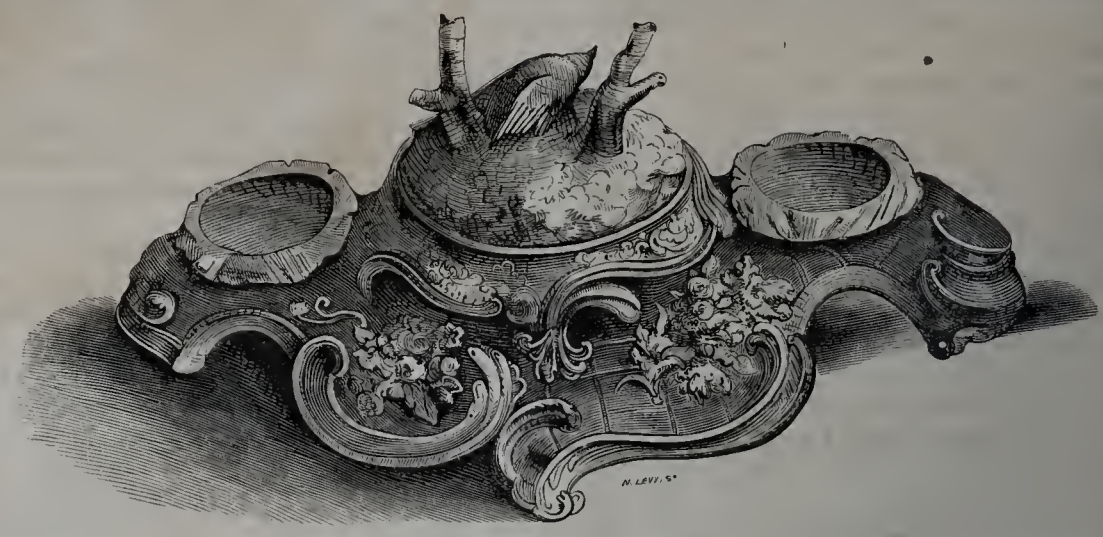
exhibited by G. Nannetti, of Dublin. It represents Venus receiving the golden apple from Paris.

We anticipate our large selection from the contributions of Messrs. Elkington & Co., by engraving here a Dagger in a richly sulptured

sheath, copied from an antique specimen of mediæval Italian production. The tripod Candle-

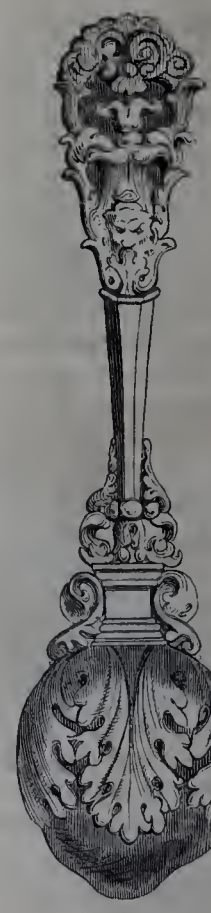
stick is exhibited by them in bronze, and in silver and gilt electroplated.

The engraving in the centre—a bronze Street Lamp—illustrates how



things of public utility may be converted into public ornaments. It was designed by B. Di Bernardis, of Vienna.

To our previous illustrations of the wood-carvings by Mr. W. G. Rogers, we here add three examples. The first is an Inkstand; beneath it, a Salt Spoon, very tastefully cut in boxwood; and the third is an



Orange Cup, the designs of which commemorate

events in the career of William, Prince of Orange.

THE FINE ARTS.—SCULPTURE.

IT is a curious speculatiou, how far the varieties of what are commonly termed *The Fine Arts*, are exhausted by certain modes of thought and consequent civilization. If we mention the usual classification into Architecture, Sculpture, Painting, and Music, it is impossible not to see that we have indicated a kind of progression. If Architecture be the first in time, and dealing with the heavier masses of matter, so it represents a more material necessity. If, of such a classification, Architecture be the solid foundation, it is certain that Music is the airy and spiritual completion, and if it be related to the rest only as ornament, it is that decoration which is equally essential, with all other parts, to the perfect whole. The most delicate bloom upon Hebe's cheek is the sweet result of her most balanced health, and is then purest when the lowest offices of the animal economy are faithfully fulfilled.

There may be found something fanciful in such views of Art. But the philosophy of Art passes so constantly into the sphere of the imagination, that it may well be excused, if not justified, in aiming to prove what seems only poetry (in the sense of beautiful fiction), by the cold details of history. And it is the constant tendency of history to reveal certain great laws in the development of the human race, to which all art, meaning by the term all the actual result achieved by man, may be referred. The lands and age in which were made the first efforts of what we will call the Fine Arts, to distinguish them from the directly and palpably Useful Arts—the primitive character of Art itself—its growth,—the gradual addition and incorporation of other arts occasioned by a higher human development—the fact that Art has proceeded by successive steps—that while each variety advanced and completed itself, the progress of Art was maintained, but in another form, and a form which may be considered of a higher spiritual significance—all these truths point directly at the conclusion, that Art, like man, advances by constantly finer varieties, and not by the steady and contemporaneous progress of all its forms.

When Architecture was in its prime, Painting was comparatively unknown. In the great era of Painting, Sculpture was a relic or imitation of the past, and Music was beginning. Egypt and India were the pioneers in civilization. Their art was Architecture. They lay at the base of history, and their forms of Art were, so to speak, fundamental. Shelter is the first absolute necessity of man which can be made the subject of treatment as a Fine Art. Greece followed. Grecian civilization was the flower and refinement of the Egyptian. Its Art, naturally, completed the earlier Art. Upon the foundation it reared the superstructure. With Greece, came grace adorning strength. The ideal of the supernal powers was elevated, and the expression arose in due degree. The rude blocks of Egyptian Deities were refined into the persuasive grace of Grecian Gods. Egypt represented brute force, the foundation. Greece was the symbol of intellect, clothing strength with grace. The qualities of character it commended and nurtured, belonged to heroism. It was the perfection of material triumph. Hence, as man is the type of informed strength, of external power in the compactest and loftiest form, and as the physical proportions of man best represent the kind of power intended, arose sculpture. It was the natural result of the spirit which inspired and created the advanced civilization of Greece as compared with Egypt. The same advance which perfected Architecture, which fluted the column, and crowned it with Doric and Ionic grace, of which only the suggestion occurs, once or twice, in the Egyptian temples—this naturally led to the finer architecture of the human form. And as the highest general Greek conception of divinity was that of the perfection of obvious, and, in such a state of society, necessary, human qualities, the Greek genius passed from the lower to the higher work, and, still dealing with the same material as the older civilization, of which it was the legitimate child, it gave the highest possible success to that material and that division of art. The rudest, earliest Egyptian temples of Aboo Simbel, and elsewhere, were the uncouth and distant beginnings of the Apollo Belvidere. Out of so strange an Egyptian seed bloomed that fair Greek flower!

It is necessary to remark that the Greek civilization did not *essentially* differ from the Egyptian. Plato, and Solon, and Pythagoras studied in Egypt. The Greek introduced no new cardinal idea of human action and character into the world. It was the primitive man more perfect; it was not a man so differently developed as to be fairly called a new man. Therefore its Art, using the same material and means, was not essentially new. And precisely as Greece may be said to have fulfilled Egypt, precisely so does Sculpture fulfil Architecture. It belongs, if we may say so, in a sense which the context will explain, to the material sphere. There was painting, indeed, in Greece; as there had been music in Egypt. The interior of the Parthenon, and the drapery of statues, were colored; and there are supposed to have been Greek pictures; there are certainly remains of such at Pompeii.

But the earliest paintings which indicate any sympathy with the spirit of which Painting was the peculiar expression, are to be traced to the decline of the Eastern Roman Empire, and were posterior to the introduction of Christianity.

Egypt, Greece, and Rome, fell. Then arose Papal Rome, the only externally organized empire of Christianity in history. A new idea, a new sentiment had been introduced into human life and character. It was the spirit of Christianity. It is not to be denied, that thoughts similar to the principles of the Christian preaching had appeared in philosophy and speculation. But the principles of Christianity had not inspired civilization until long after the decline of the old philosophies, and the fall of the empires of which those philosophies justly expressed the average sentiment. The height of material development had been achieved. The Egyptian spirit and the Greek spirit had triumphed in Life and Art; and the forms of that art had strictly corresponded to that material development. Those arts would, under new inspirations, take new forms. The question is, could those new forms be more than adaptations of the old? Would not the new spirit instinctively create an adequate and peculiar form?

The answer is, the art of Painting, which, in illustrating the idea of Christianity and supported by the patronage of the Christian church, reached its culmination. The new ideas were spiritually discerned. The qualities of character peculiar to it, were not the heroic nor those which can be best expressed by physical prowess. It implied something more than the beauty and grace of the Apollo and Venus, something subtler than the wisdom and might of Jupiter and Minerva. Mythology was material, in comparison with the spirituality of Christianity. But as this different principle implied a play of character, a variety in unity, arising from the universal sympathy, which is the soul of Christianity, its Art must be susceptible of the same varieties and gradations. A Greek God represented the completeness of one attribute, or quality, or sentiment. To the representation of that, *form* was quite adequate. But the representation of a Christian saint, or scene, was full of such various emotion that form alone could not express it. Hence color, as the means of graduated and various expression, was added to form. Thus Painting was the younger sister of Sculpture and Architecture, and as no new element of human conduct or life has been actually introduced since the Christian Painting reached its highest historical point, in the fifteenth and sixteenth centuries, therefore since that period it has been either a reproduction of that old tradition, or a simple imitation of nature, which is obviously a lower level of the art.

Music seems to be almost too exclusively dependent upon a caprice of Nature, in furnishing an ear, to be submitted to the analogies of this speculation. Thus much is, however, evident, that, in the degree that the whole tone of human life has become elevated by obedience to the Christian principle, has music matured, and as the great sculptors had declined before the great painters arose, so were the latter gone before the musicians came. Phidias was a memory to Raphael; and Michael Angelo to Beethoven.

Yet as Philosophy seeks constantly to trace relation, and dependence, and general unity in every phenomenon of progress, it is not difficult to see that, as Egypt founded and shaped the structure, thereby representing Architecture, so Greece completed it and adorned it with ornaments suggested by a similar spirit, thereby representing Sculpture; and so Italy, with a new inspiration added a new essential in Painting, while subtle, Gothic Germany (following the image) pours through the aisles, and past the statues and the pictures, a torrent of music, crowning with speech the perfected work of the ages. And, clinging to this general idea of sequence in unity, it is a favorite thought of the greatest artists, that the completest work of Art is a temple, sculptured and painted, in which music wafts a universal anthem of worship to Heaven.

The theory, shadowed forth in such a speculation upon the historical surface of Art, is, of course, that certain forms of art are peculiar to certain periods of History, and to certain degrees of development; and that whenever, at other periods, works, in that kind, are attempted, they can only be successful in a limited degree; that, absolutely, they aim to do what has been already done; and that, relatively, they can only legitimately represent that which is the peculiar subject of that form of Art, but which, as the greater includes the less, still exists as it did in the time when it was the chief and remarkable aspect. In other words, that, absolutely, such attempts are partial, or aim only at the representation of a part, which part, in the days when that particular form of Art was in the ascendant, was the whole; and that, therefore, relatively, that form of Art cannot aim to embrace the present whole, but can only succeed as to that part, which is only one division of the present whole.

This can be made clear, we hope, by an illustration. The Greek Venus is the symbol of perfect material grace and loveliness. Now at a time when that is the highest ideal it can be perfectly expressed in marble, and a statue is made. But now let us suppose the Christian Madonna, to represent whom, marble is obviously inadequate. Why? Because the idea of the Madonna requires a spiritual variety which cannot be sufficiently expressed in stone. Yet, as the highest ideal of womanhood, it necessarily contains that lower one of material grace and loveliness, and therefore an artist, aiming to make a statue of the Madonna, could only succeed in so far as he adequately presented that lower one. But in view of the higher ideal, and of an art competent to express that height, of course, in representing the lower, he is only representing a part, which was once a whole. He is aiming at an old result. It may be a very pretty thing to do, and may be done as well as in the old days, but, in view of the high requirements of Art, it is an imperfect success.

This may be seen conversely in various ways. The best of the Venuses of Painting, are those of Titian, but they are good only as they are made expressionless and inane, while the very necessities of color give an undue prominency to the voluptuous side of her character; on the other hand, there is a physical purity of expression inherent in the very necessities of marble, which adapted it to the Greek purpose of representing in human form something mysteriously beyond the human. It is singular, in the Tribune at Florence, to look up from the Venus de Mediei to the Venuses of Titian. It is like glancing from Susannah, pure, shrinking, but full of womanly warmth and natural passion, to Ninon de l'Enclos. In the same way, as the Venus is less successfully represented in painting than in marble, so it is curious and important to observe that the figures of Christianity are very imperfectly presented in marble, while they are quite perfect in painting. If the reader will remember, he will find that there are no great historical and satisfactory statues of Christ or the Saints, and for the reason, we think, before stated.

Looking now at the subject, historically, with the intent of ascertaining if Sculpture was peculiarly the Art of Greece, and of an old civilization, what do we find?

We find in the first place, that no other nation has ever created a new style in Sculpture; and, secondly, that success in Sculpture has been always in proportion to its reproduction of Greek subjects in a Greek spirit.

Old Rome had no Sculpture worthy the name. It mistook the colossal for the grand, and has left us various enormities in stone and bronze. When the great period of Painting arrived, in modern Italy, many of the chief artists being universally accomplished men, could chisel statues in addition to painting. We instance Michael Angelo and Raphael. The chief work of the latter in Sculpture is preserved in a church at Rome, and has much of his sweetness and grace. The works of the former are distributed between Rome and Florence: and his fame is, perhaps, greatest as a sculptor. His statues are among the remarkable works of Art. He made allegorical works such as *The Night and Morning*. But as successes they are not to be allowed. They are full of grandeur and grace. But they fail in the first element of imitative works: they tell no story. A Greek would always recognize any image of any god he knew. A Christian, versed in the legends, would recognize any saint, and of course the Christ and Madonna. But what observer would ever know what the figures upon the Sarcophagi in the Florentine Chapel intended? They are allegories in stone; so far as the purpose of Art is concerned, they are vague, mental chimera in marble; they are, in truth, precisely what the imagination of the spectator chooses. In his Christian Sculptures, the *Pietà* in St. Peter's, for instance, and others, there is a want of holy, spiritual elevation, a triumph of physical suffering over the might of mind, which degrades the subject. His best work in Sculpture is the sitting statue of the Mediei (the name escapes us), in the Florence chapel. But that is wrought strictly in the Greek spirit, that is to say, in a spirit of simplicity and truthfulness, aiming to give a portrait of the man. There is nothing essentially different, except it may be as a matter of mere detailed work, in the statue of that Mediei from the old statue of Demosthenes. So far, it is only an imitation, or at least a reproduction. The *Bacchus*, in the Uffizi Gallery at Florence, is a Greek subject, treated, therefore, and instinctively, in the Greek manner, and is so far successful, that it might be accounted a genuine old Greek sculpture. Michael Angelo's success in sculpture was in proportion to his following the Greek. When he departed from this law, he fell into an obscurity of which he seems to have been, himself, conscious, as may be seen in the fact that his other great works are mostly unfinished. It is as if he felt that he had not succeeded; as if he, who was really subject to the new inspiration, were struggling to express himself in the forms of the old, and was therefore compelled to leave the results incomplete. That which he failed to do in stone, however, he did triumphantly in color; and the Sistine Chapel atones for that of Florence. The Prophets are as grand, in a higher kind, as the Phidian Jupiter.

After Michael Angelo, came Bernini, who merely caricatured him. Then, after many years, Canova, who was simply and purely an imitator of the Grecks, to whose spirit he added an Italian sentimentality, both in choice of subject and treatment. He is of no especial account in the history of Sculpture, except that he returned much more nearly to the Greek purity of form than any of his predecessors. Just after Canova came Thorwaldsen, and before his death, Powers. There were of course other men who pursued Sculpture, producing busts and statues, and succeeding, both in making pleasing figures and in securing a temporary reputation. The German Schadow is to be mentioned honorably among them.

Now, in walking through the studios of Sculpture for the last hundred years, what do we find? We find Greek subjects, mythological and historical, treated in the Greek way. How much would the spectator infer from such a view that the world had actually advanced about two thousand years in time, and into an entirely new spirit of Life and Society? Is there any thing in all those studios that could not have been wrought infinitely better, in the old Greece of History?

There are some exceptions to this statement; but they are of the kind that only confirm it. Thus it may be asserted, that the Christ and Apostles of Thorwaldsen are certainly not Greek. But the question is, Does this group satisfy the mind to the degree that the same subject in Painting, does it? For instance, is it so adequate to the theme, so full of the peculiar spirit of Christianity, as Lionardo da Vinci's painting of the Last Supper? *Could* it be so adequate? Is it not limited by the very nature of the art and of the material in which the work is wrought? What are Thorwaldsen's greatest works? The *Triumph of Alexander*, the *Mercury*, *Jason's Conquest of the Golden Fleece*, the *Night and Morning*, the *Ganymede*, and the *Christ and Apostles*. But, while the Greek subjects are only inferior to the original Greek in simple grandeur, for no sculpture has yet rivalled the Elgin Marbles, the Christian is inadequate. And it is so, as we believe, because Sculpture is an art peculiar to the spirit of Greek civilization, and therefore perfected by the nation of which it was the just expression. Thorwaldsen, in modelling Christian subjects, merely obeyed the spirit of the time in which he lived. His feeling and inspiration, like his material and success, were Greek.

If we consider the group of Christ and the Apostles, now exhibited in model at the Crystal Palace (the originals stand in the church of *Notre Dame* in Copenhagen), we shall find that their excellence is an excellence peculiar to Sculpture, but very limited. The chief figure is not successful: it is colossal, which is an error, because the sense of spiritual superiority is lost in the unnaturally gigantic proportions. The attention, *as is necessary in the very nature of Sculpture*, is diverted to the *form*, to the external, while the success sought is internal and spiritual. The figures of the Apostles have an unavoidable stiffness, arising from the necessities of regular grouping. Sculpture does not allow that distribution which was essential to the subject. Compare with this, again, the *Last Supper*. In the sculpture the face and attitude of each Apostle are symbolical so far as is possible. But in this the Sculptor has only followed the tradition of Painting, and, by reason of his material, has lost much of the effect intended. John and Paul, the body and soul of the Christian law, are more perfect in many pictures than in this Sculpture.

The result seems to be that Thorwaldsen has done the best he could do under the circumstances, but that the greatest success was impossible with such means. He has only copied in marble what already exists more perfectly in color; and it has not been attempted in marble before, because, with a new sentiment in civilisation, a new and more pliable, and therefore more adequate, form of art was introduced. What success he has achieved is Greek. The purity of form, the propriety of action and the simplicity of expression, are Greek. But they are only Greek.

If we turn to the works of Powers, we must confess that his great and undoubted excellence is that of the old Greek Sculpture. He shows a fineness of detail, an elegant elaboration, which is not often found in the antique, which is the result of Yankee shrewdness and mastery of the means, working upon received models. Powers's great works are all represented at the Crystal Palace: the *Greek Slave*, the *Eve*, the *Fisher Boy*, the *Proserpine*. He has an *America* and a *California* under his hands in Florence. The extreme beauty of these figures, their delicate grace, and the exquisite refinement of their execution, are matters of the history of Art. They are much superior to the statues of Canova, not only in workmanship, but in purity of feeling. There is something meretricious in the works of Canova, which the least thoughtful observer detects. What is to be said of his *Venus?* What of the *Graces?* What of the *Hebe?* They are ballet-girls and *dames du theatre*. They are not the visible forms of an ideal grace. The works of Powers have a naturalness which is strictly Greek. They are figures of still life. They represent no passion, no variety, no action of any kind. The face of the Greek Slave is pure and passionless. It is as beautiful as the usual type of the Greek faces; but it has not the subtle and searching beauty of the *Clytie*. It is external in sentiment, if we may say so. It is a delicate and successful imitation in marble of a young female form. But it is no more. The chain upon the wrist does not make the figure a slave. We look in the face, not at the hands, of a slave, to feel the shame and the indignation. It was Byron's imagination which saw the rare vision he has immortalized as arising from the spectacle of the *Dying Gladiator*. The stone only represents a man, wounded and falling. If you call him a gladiator, and remember what the fortune and fate of a gladiator were, then you will feel as Byron sang. But such vague and general suggestions are to be regarded, in respect of the success of a work of art, only as the imaginary completion of the Vatican Torso. Michael Angelo, looking at the Torso, may imagine it perfected into the full image of a God; but it is not therefore correct to say that the Torso is the statue of a God. The truth is, that the sculptor who made the Gladiator, even if he intended a gladiator, which is a matter of grave doubt, did not mean all that a vivid imagination could supply, unless it be asserted that every work means all that it *can* mean to any mind. This may be true in strict esthetics, but it is not practically correct, because, in such a case, the old Byzantine Madonnas must be considered equal successes in art with the Madonnas of Raphael. By such a rule, also, the face of Powers's Eve must be admitted to a triumph as complete as the face of the Sistine Madonna, for they are undoubtedly both intended to represent beautiful women.

Detailed criticism upon the sculptures of the Crystal Palace is rendered somewhat unnecessary by the general principles we have suggested. They will, we think, be found fully to justify those principles. If we turn from Powers and

Thorwaldsen, what is there in the department of sculpture but a series of various figures imitating various actions? The veiled statuary is only a pretty trick of skill. The *Girl Threading a Needle* is a "cunning" and pleasant work. The equestrian *Washington* is huge, and the *Webster* is ludicrous. The famous bronze *Amazon* of Kiss is full of fire and a wild grace; and the bronze imitations of animals and birds throughout the exhibition are admirable; but not one is superior in conception or workmanship to a *house lizard* in Dr. Abbott's Egyptian museum, which is probably twice as old as the statue of the Apollo Belvidere.

We have surveyed the sculpture from the highest standard. It is our belief that *Art*, which is, in some form or other, contemporary with Nature, is susceptible of many varieties. That some one of these varieties culminates with every great recognised epoch of historical civilisation, is peculiar to that period, and is only to be successfully practised in a subsequent period, in a limited degree. That, as the race is progressive, so Art must be; and that each new form is more pliable and expressive than each of the preceding, and includes them as the greater includes the less. That all forms of Art are mutually related, each new one being superior in intent, as it is more various in execution, yet that all are necessary to an exhaustive survey of history. That Egypt, Greece, and Italy (to which may possibly be added Germany, for music), represent the three great forms of Art hitherto developed. That Egypt was the fundamental, or the architectural. That Greece was the fulfilment of Egypt, in laws, manners, religion, and life, and that consequently Egyptian Art received its last perfection in Greek architecture and sculpture. That Italy was the seat of the new element of Christianity introduced into history, and therefore produced a form of art adapted to the fit expression of that spirit; necessarily more subtle and various than the preceding forms. That, in illustration of this theory, history shows sculpture to have touched its prime in Greece, that all subsequent sculpture is successful only in the degree that it represents ideas peculiar to the Greek civilization, and therefore susceptible of a Greek treatment. That, consequently, all modern sculpture, by which we mean all since the Greek, is of no historical significance, and bears no intrinsic evidence that it was not executed two thousand years ago, having no relation to a different spirit of life, and that when it has aimed to represent a different spirit it has signally failed, thereby showing its inadequacy. That, in the same way, contemporary painting is merely imitation; that it constantly reproduces an old story in the old way, or contents itself with portraiture, either of man or the landscape; and this, necessarily, because we live under the Christian civilisation; nor can we look for a new art, until some more universal principle is deduced from Christianity, and incorporated into the life of the race, which we are not inclined to believe so distant as some other things. "Good will to man" is practically organized in democratic forms of government, and must, at some time, appear in Art.

In the necessary limits of such an article, which we have already surpassed, we can do no more than suggest these principles. We have but partially applied them to the sculpture in the Crystal Palace. Let the reader measure the paintings of the Exhibition, by them, and we have no fear that he will find a different result.

We cannot farther follow the thousand interesting thoughts suggested by the discussion. It is one of the great triumphs of the Exhibition, that it will cause every thoughtful man to meditate more and more deeply upon a subject whose relations, like its influences, are endless.

ENGRAVING.

WHAT typography is to the author, engraving is to the artist. The relation, of Guttenburg and Faust to literature, is kindred to that which Finiguerra and the unknown originator of wood engraving bear to art. It is scarcely more possible that the mass of mankind should form an intimate and familiar acquaintance with the masterpieces of art in their original forms of statues and pictures than the world should read Bacon and Scott in the original manuscripts of the authors. Yet the value of art is almost proportionate to the diffusion of its products, and to the existing extent of culture among men of a correct and refined capacity for appreciating art-creations. Not only do the pictorial arts contribute to the tasteful enjoyments of life, but they are steadily growing to be the habitual vehicle for an immense amount of knowledge relating to architecture, machines, and apparatus, to natural scenery, natural history, and natural philosophy, to the incidents and surroundings of social and domestic life throughout the world, to the events and accessories of history, and, indeed, to all learning which involves external forms, whether of natural or human origin. So readily does the mind receive knowledge through the eye, that the wide prevalence of pictorial illustration deserves to be ranked among the most powerful aids in promoting its diffusion and application. Whether viewed economically, socially, mechanically, or æsthetically, a high aggregate importance most rightfully belongs to the numerous and rapidly increasing group of art processes having for their common object the production of imitative forms, whether actual or ideal. Restricting ourselves to that portion of these arts included under the head of engraving, and excluding all kinds of engraving except such as have for their object the procuring of ink impressions on paper, we shall still only find it practicable briefly to allude to the more important processes for print engraving and printing.

The origin of engraving is remote and obscure. The ancients engraved gems, seals and medals, in high beauty and perfection. But engraving for printing purposes dates back only to the origin of wood engraving, which is believed, though on slender evidence, first to have existed in China, and then to have been either transported to, or invented in Germany, as early as 1285; so obscurely, however, that a rival Italian claim to its invention is maintained, though no record prior to 1441 testifies to its having been there practised. The invention of movable types would appear to have resulted from printing engraved wooden blocks, typographical and woodcut printing being in fact essentially one discovery. Though Germany also claims the origination of printing from engraved metal plates, it appears most probable that there were two distinct discoveries of this art, and that the first to apply metal engraving to printing was Maso Finignerra, a goldsmith and sculptor in Florence. He practised *niello* work, in which designs are engraved on metal plate, vases, &c., the engraved lines being finally filled with a black fusible mixture of silver, lead, copper, sulphur, and borax, which brings out the design strongly. To preserve copies of their designs, *niello* artists were wont to fill the engraved lines with black earth, and run over them a layer of fused sulphur, which took up the earth and thus formed a species of impression. Finiguerra used a mixture of oil and soot, and substituted paper for sulphur; thus originating the art of printing engravings, and of engraving for printing. Hence, through a natural progress, the art has advanced by successive additions to and perfectings of its methods up to its present full expansion. Plate engraving, wood engraving and etching attained respectively to a high degree of perfection in the hands of Martin Schoen, and Albert Durer, in Germany, and of Raimondi, in Italy, early in the sixteenth century. The dawning history of engraving shows that a higher order of artists applied their talents at the first to developing the powers and resources of the graver and etching point, than is found in the list of later masters and practitioners. Albert Durer, Goltzius and Rembrandt, in Germany, Parmigiano and Della Bella, in Italy, and Callot, in France, practised engraving directly on plates without previous painting, and many of the most spirited modern etchings are drawn first on the plate. Indeed, the power with which lines were used by those early master hands makes the mere dexterities and mechanical perfections belonging to the present routine of engraving practice, appear but very unsatisfactory substitutes for the rough, bold vigor, which they have in great part superseded. The excessive subdivision which now restricts each engraver to a special mode of working, and to a special line of subjects, while it exalts the finish and style of execution has the effect to cramp the engraver's faculties, and to produce in his work a confirmed mannerism, which ignores the spirit of the particular subject in hand, and prostrates its peculiar significance before technical rules. The truly good engraver unites finish of style with a soul for meanings, and hence knows how to suit each to the other.

The arts of engraving are reducible to the classes of engraving in relief, and engraving in basso, or in sunken lines and points. Zincography and the several lithographic processes (except stone engraving), present their subjects on flat surfaces without enough either of relief or depression sensibly to affect the printing. Relief engraving is chiefly limited to the two styles of woodcuts, in one of which the lines of the subject are printed dark on a light ground, and in the other they are left light on a dark printed ground. Cerographic lines in relief are also used for coarse maps. The processes in which the parts to be printed dark are cut into the plate, and then filled with ink for printing, are more numerous. They are, copper plate line engraving, steel plate line engraving, stippling or dot engraving, etching copper or steel through a laid ground or coating, aquatinting, mezzotinting, and lithographic dry-point engraving. A wide difference prevails in the mode of printing relief, flat and sunken engravings. Relief lines are charged with ink by merely passing the ink roller over them, as in distributing ink to an ordinary type form, the process being the same throughout for both, except that woodcuts are sometimes printed against a backer, so patched or underlaid as to throw the greatest pressure on the parts intended to be darkest, while the lightest portions are relieved. In Zincographic and lithographic flat surface printing, the light parts require to be wetted between successive impressions, as the water coating protects the lights, while the printer rolls his charged ink roller over the lines, and dots, to be inked and printed. In printing basso, or sunken line and point engraving, the method pursued is to roll a charged ink roller over the face of the plate, so as to fill its depressions with ink, the plate being heated to facilitate this end. The surplus ink is then wiped from the plane face by rags, and by the palms of the hands. This hand wiping enables the printer in part to regulate the amount of ink with which the portions of the plate are supplied when printed, and the control over the shade of his proofs thus obtained, nothing but the hand palm has yet sufficed to give; hence, however begriming and distasteful this use of the hands may be, they are likely always to continue as tools for fine printing. When the wiping is completed, the plate is laid on the bed of the press, covered with a sheet of printing paper, and drawn by a crank movement under a

cylinder, which subjects it to a pressure so powerful as to force the paper against the ink in all the engraved lines. Then on lifting the paper from the plate, the ink adheres to the paper surface in ridges and peaks, corresponding to the cut lines and dots of the plate. There is room for a high degree of skill in plate printing, and it is almost as rare to find a good printer as a good engraver. Not only must a first-rate printer be versed in all which concerns paper, inks, presses, plates, and their peculiar workings, but he must have sufficient artistic appreciation of his subject to give it the best and best distributed tone of shade. This indispensable adjunct of art has not received due attention, especially among ourselves, and a reform of this neglect must be achieved before the best American engraved work will compare favorably in proof with the English, French, and Italian products, since their superior printing gives an important vantage ground to their artists of all grades. We will now present a brief synopsis of the chief engraving processes.

Wood engraving is now uniformly executed on blocks of boxwood cut across the grain, into slices one inch thick, and planed smooth on the face. Good blocks are characterised by a uniform yellow, plane surface, while the prevalence of red or white colors, of knots or of flaws, indicates inferior blocks. Blocks of from six to eight inches square can be procured, but for larger subjects, two or more can be joined. An important improvement or revolution in wood engraving was effected by introducing the use of boxwood blocks, a step which originated in this country. To the superior clearness of lines given by this wood, and to the recent wonderful development of a popular demand for cheap illustrations, we may ascribe the immense increase of woodcuts employed during the last twenty years. The fact that woodcuts can be printed, with the utmost facility on the type press, enables them to be composed with letter-press, and worked off with the forms of books, magazines and newspapers, in almost unlimited numbers, especially as either stereotyping or electrotyping can be resorted to when desirable for their preservation or reproduction. Preparatory to executing a design on wood, the face of the block is slightly roughened, and then covered with a moist powder of Bath brick and flake white, which, when dried and brushed, offers a fine white surface to receive the drawing. This is either drawn in pencil on the block, or is transferred from the original drawing by tracing, or by throwing down its ink on the white ground. The white parts are then cut away by the use of gravers, tint tools and gouge tools, leaving the dark lines in relief. As in the printing the dark masses of the drawing should receive the greatest pressure, and the lightest lines the least, the surface of the block is prepared for engraving by lowering slightly according to a traced outline the parts on which the lights are to fall. Then the ground is whitened, the drawing on it made, and the engraving executed conforming in its details to the previous lowering. This lowering, which makes the block complete in itself, is far superior to the method of patching or underlaying, which it is superseding; as the arrangement of underlaying patches to regulate pressure, threw too much on the printer, and was lacking in delicacy of adaptation.

Wood engraving has two modes exactly the reverse of each other. Not only is wood used to print the drawing lines in black or from relief, but it is employed for printing the ground in black, while the drawing lines being cut away on the block, are left white in the impression. The latter mode is exceedingly effective for outlines and mathematical drawings, to which it gives a striking relief; it is also much more cheaply executed. It is growing into more extended use, and is well exemplified in Baillière's Scientific Series, and in the Crystal Palace Dome Section given in No. I. of this Record. Its relation to common wood engraving, is the same which mezzotinting and aquatinting bear to line engraving on copper and steel.

So important is wood engraving to popular art-culture, that it should be sedulously cultivated, for improvements both in its processes and in its style. It is far short of perfection in both these respects, and just now it is peculiarly the victim of an overbearing demand for the more indifferent styles of work. It is much to be regretted that so strong a tendency now prevails among us to multiply engravings, which in all points of style and meaning are beneath criticism. The art thus becomes discredited, and the better class of artist mind turns from a method so prostituted to the service of deformity. It would, however, be more wise for some real artists boldly and diligently to enter on a better practice and application of wood engraving, and the present time seems peculiarly to invite the enlistment of some more masterly minds in a career where so much good can be achieved by raising the tone of popular illustrations. Not only distinction but also emolument now particularly invites to this career, nor need one scorn to follow in the footsteps of Albert Durer. Elements of power abound in this art, and it well deserves to be exalted to a higher rank by enlisting that eminent order of talent which adorned its glorious dawn. The long neglect in which it had lain, gave place during the present century to that strangely active agency which we now behold in the London Illustrated News, the Art Journal, L'Illustration, and numerous other instances (we might specify this Record); an activity which must go on increasing, and which will fully justify every effort to give a higher character and spirit to an art so boundless in its scope. A country which can claim an Anderson and an Adams, is certainly not without materials for the highest practice of this art; and if superior woodcuts, equal to that from Wilkie's Blind Fiddler, are not produced here, it is because the demand has been so exclusively for petty subjects. Why does not some one among us try the experiment of woodcuts really of the first class in subject, style, and dimensions? A great original cost, even if it were necessary, would be amply reimbursed by an extensive popular circulation at the lowest remunerating rates.

Copperplate engraving has perhaps employed the very highest skill in the use of the graver, from the days of Martin Schoen to the present, and it has been the means of producing a great number of truly noble works of art. Copper plates for engraving require to be very pure, and are planished, or hammered plane and polished before using, so as to give more hardness and uniformity to the surface. In copying on copper, locating squares are lightly drawn on its face, and a thin coating of wax is spread uniformly over it, by heating the plate. Then the drawing is traced in pencil on tracing paper, or sheets of fish glue; the tracing is then reversed according to the squares, with its face on the wax, and is either run through a press, or the pencil marks are thrown down by hand, so as to effect their transfer to the wax. Then with a point these outlines are traced through the wax into the copper, where they serve as a guide for all the engraver's subsequent cutting. The graver is employed exclusively for cutting strong lines into the copper, and for filling in the details the graver and dry point are used. The graver point is a rhomboid, varying in its angle in different gravers, and it is pushed in front of the engraver's hand. The scraper is a three-edged pointed instrument, used for scraping off the burr from the lines, and for erasing by hollowing out. To beat up to the plane of the face the hollows made by the scraper in erasing, a small anvil is used, on which the plate is held while the hollows are bumped up by hammering on the back. The burnisher, a round pointed tool, is used to rub out light lines and surface inequalities. The ruling machine, an invention of Mr. Wilson Lowry, of London, is used for ruling in with a diamond or hardened, steel point, the parallel lines for skies, water, and uniform shading, giving great delicacy and evenness of shade. When the engraving is complete, the burr on the sides of the engraved lines is removed by the scraper, and the plate is rubbed over with coal to give it a smooth face for printing.

Steel engraving differs from that on copper plates, not in the tools used and the methods employed in their manipulation, but in the manner of treating the plates themselves. The process of decarbonizing and recarbonizing steel, whereby it is made soft during the engraving, and then hard for the printing, is due to the inventive mind of the late Mr. Jacob Perkins of Massachusetts. About thirty years since, he matured the means which have served to establish a very general use of steel plates for the finest class of subjects. His method, for which he procured an English patent in 1823, is briefly the following: The steel plate, die or cylinder which is to be softened for engraving, is imbedded in iron filings, and inclosed in a strong tight iron box. For about four hours this is exposed to a white heat, which deprives its surface layer of a portion of its carbon, in fact thus rendering it essentially soft iron, on which the graver works with a facility approaching that of copper engraving. When the engraver's work is done, the hardening or recarbonizing is effected by bedding the plate in a close iron box filled with pulverized charcoal derived from leather by dry distillation, and then heating the whole to white heat for a time, proportionate to the thickness of the plate. Then the plate is withdrawn, and tempered by plunging into cold water, a process requiring for its practice, trained skill to guard against cracking, warping, and imperfect temper. This results in giving a degree of hardness which enables the plate to furnish a very great number of perfect impressions, thus presenting a most important advantage over copper for standard engravings. Whereas copper fails in from 1000 to 3000 impressions of good work, and 6000 for the coarsest, a steel plate often will give over 50,000 impressions even of good engravings, and over 100,000 for the coarser species of work as school atlases. On the whole, steel is capable of rather finer work than copper, though its engraving costs from a third more to double that of the same subject on copper.

Mr. Perkins also invented the process and the press used for multiplying copies of steel engraved plates. For this purpose he used rollers of soft decarbonized steel, which are by the press rolled over the engraved plate under so strong a pressure as to force the soft steel into the lines of the engraving, thereby presenting on the cylinder a raised direct copy of the engraved subject, which being duly hardened, is made in turn to stamp its lines into a new softened plate. Thus from a single engraving, an infinity of impressions can be procured. Unfortunately the pressure required is so great as to prevent the application of the press to any except small designs. It is peculiarly applicable, however, to bank notes; for by its agency, the heads, vignettes, ornamental figures, &c., of a bank note can be readily repeated in perfect identity on the same plate, so as to permit the printing of a bill in sheets of four and six copies at a time, with but little extra cost for engraving after the first copy. Thus skill, without restriction of expense, is bestowed on the elements of bank notes, as these can be used not only in the several copies on one plate, but in various combinations for different plates, and even for different banks. The very best engravers in this country are thus employed, as may be seen by inspecting the specimens of bank note

engraving exhibited at the Crystal Palace; a fact which affords an excellent check on counterfeits. Some of these, and other American engravers, rank very high in their profession, though unfortunately there rarely happens to these artists, an opportunity of applying their talents to those great works indispensable for an established reputation.

Stippling is a peculiar species of engraving, in which effects are produced solely by the use of dots, or indented points, made either with the graver, the point, or by etching. The graver dots or holes in the plate are angular, and those made by the dry point and etching needle are circular. Their grouping and degree of crowding, regulate both the lines of the subject and its distribution of light and shade. The heaviest shades are produced by condensing the dots, and by opening them out, the gradation into white may be realized in the softest and most delicate manner. Stippling can be used with exceedingly beautiful effect in rounding the arms, cheeks, and other swelling parts of the human figure, and especially in copying the soft lights of statuary. It is also well adapted to vignettes and flowers. This method of engraving dates back to the beginning of the seventeenth century, and was revived with much improvement near the end of the eighteenth century. The English have acquired a very marked superiority in this style, and many fine instances of its use may be seen in the Art Journal. Ryland and Bartolozzi are names of special distinction in this field. In arranging the dots, they are placed with some regularity in curved lines, as a random order of location would give a patched and rough look to the tints. The dots being made by the graver or dry point, burrs or swellings are raised around the rim of each indentation. This prevents the completion of the dotting at once, and makes it necessary to use the scraper for removing the burr, when dots are again interpolated. Several scrapings of the burr may be necessary. Sometimes in stippling, a roulette or mounted spur-wheel is used for running in dots, but it is rather an unmanageable tool for this purpose, and not proper for the best work. The required effects are governed by the size, and placing or condensation of the dots, and the good management of these two elements demands all the skill of the engraver. Stippling is a slow and very costly mode of engraving, nor can it be appropriately used except in subjects where a peculiar softness of effect is desired. The *Opus Mallei* species of work hardly constitutes a distinct style of engraving, nor is it much used. It belongs to the seventeenth century, and was first practised by James Lutma. It is executed with a minute chisel, or a short and sharp point, which is struck by a small hammer. It is chiefly restricted to harmonizing designs already etched or drawn.

Etching is a general name for all the methods of engraving on metals or glass by the use of acids. More definitively it is the mode of engraving by laying a protecting ground over the surface of a plate, and drawing through this ground with a needle or etching point the lines of the design, which by the application of an acid, are bitten into the plate elsewhere protected by the ground layer. Albert Durer is supposed to have invented the art of etching, as his works are the earliest in which its use is traceable. It has been practised by many first-class artists, though the palm of highest excellence is conceived to be due, at least in the architectural department, to Piranesi, a Venetian, who died in 1770. Etching is used either for the entire completion of engravings, or the stronger etched lines are retouched by the graver, and the irregularities of other etched lines are in like manner removed. Stippling is also executed by the needle on etching ground, and then bitten in. The use of the etching needle bears a close relation to drawing with the pen or hard pencil, and the lines of etching have that free flowing character which the graver cannot realize. Etching has some points of decided advantage over the graver, and some as decided inferiorities, especially in the unevenness of the acid action and the consequent raggedness of its lines. Hence a combination of the two is very much employed, in which the graver superadds its own excellencies to the ease of the etching needle.

The ground composition is a mixture of asphaltum, Burgundy pitch and beeswax, which is formed into a ball, and enveloped in a silk cover for use. It is applied by rubbing it over the heated plate, and is smoked with a taper to make the drawing apparent. A soft ground is also sometimes used for etching, in imitation of chalk drawings. The hard ground composition is mixed for this purpose with mutton suet or lard, and over this oft ground a sheet of thin paper is stretched. The drawing is then made on this paper, and when it is removed, it lifts off by adhesion the soft ground from the plate where the lines and shading strokes fell, so that on etching an imitation of the drawing results. When a drawing on a hard ground is completed with an etching needle or a point, it is inclosed in a ridge of bordering wax, and a solution of nitric acid is poured on. This attacks the metal through the lines, and an effervescence results, the bubbles of which are carefully brushed from the plate by a soft brush or feather. When the biting in has progressed as far as required by the lightest work, the acid is poured off, and these parts are coated with varnish, or stopped out as it is called. The biting is then renewed, and the stopping out extended as often as required for the best effect in the engraving. Then the plate is cleaned, retouched by the graver, and the bordering and lettering added. Both copper and steel are extensively engraved by etching, the process being much the most rapid on steel.

Aquatint engraving was invented about 1662, in France, by St. Non, and was introduced into England by Paul Sandby. It has been practised in England with much better success than elsewhere, and is among the important facilities to art publication. Its effect is similar to that of India ink or sepia drawing, and it is much used for good works which are to be colored. The outline being drawn or etched very lightly on the plate, it is polished, and prepared for laying the ground. This is laid by pouring a solution of resin in spirits of wine over the surface of the plate placed slightly sloping, until the whole surface is covered, when the plate is quickly turned to a horizontal position. The spirits of wine rapidly evaporates, leaving the resin in a granulated form on the plate, and producing a minute network of open lines, through which the acid can reach the plate. The quality of the graining is affected by the strength of the resinous solution, the quantity applied, the slope of the plate, and the time during which it stands aslope after the solution is poured on. The ground being prepared, the next process is the stopping out, as it is called, or the laying of a varnish on the lights to be protected from the acid. The margin and the white lights are stopped out before the first etching takes place; and then this proceeds until the biting has progressed far enough to give the lowest tone of shade, when it is arrested, and the stopping out is extended to all shades of this class. By repeating this process the heaviest shades are produced at last, and the plate is finally cleaned. Then the scraper is applied to bring out the lights when requisite, and the burnisher is used for softening down the joinings of the successive shades, and for toning down such parts as come out too dark. Much care and skill are required for the successful practice of biting in, while the stopping out requires the same qualities in the artist as water-color painting. Much diversity of practice prevails among different engravers in the details of aquatinting, and on the whole, this species of work is capable of producing the finest or the very worst effects, according to the skill exercised in its practice.

Mezzotinting was invented in 1611, by Louis Siegen, or by Prince Rupert, or by Sir Christopher Wren, for each of whom claims are advanced. It has been most successfully practised in England, and it is very advantageously applied to night scenes, or other subjects demanding a dark ground, for which it approaches the effect of oil paintings. Mezzotint plates unfortunately wear out very rapidly, generally giving only about 200 good impressions, though the facility with which they are engraved in part compensates for this defect. It is also difficult to print mezzotints well, though a successful impression has a peculiar power of light and shade, which no other style possesses.

The mode of engraving is quite peculiar. First of all, the whole surface of the plate is so filled with intersecting cuts, that it will print a uniform strong black tint. This is done by rocking with the hand backwards and forwards, under a slight pressure and over the entire plate, a cutting grounding tool or sharp-edged segment; then lines are thus cut crosswise, and again diagonally. Thus the surface is thoroughly worked over and covered with intersecting lines, which give a black impression. Grounds are sometimes prepared by etching and by dotting with the roulette. Rembraudt so cross-ruled etching grounds as that the plate printed black. We have seen a tint produced by printing from the parallel ruling by a machine, which was so delicate that the naked eye could scarcely detect the lines; and this, if cross-ruled, would have given an exquisite dark ground. Saulnier has applied a special machine to mezzotint grounding, and ready grounded plates are now an article of regular trade supply. On the ground, however prepared, the drawing outline is transferred and traced with the etching needle, and the lights are then produced by scraping out the ground with the scraper, and by smoothing it down with the burnisher. The extent to which the ground is removed, measures the light which will result in the print. The engraver has for his task to produce strong lights by entire erasure, medium lights by moderate burnishing, and to preserve the original ground for deep shades. Thus mezzotinting and aquatinting are like dark ground wood-cutting, in the fact of engraving the lights, and leaving the shades.

Engraving on stone is much used for maps, botanical illustrations, and mechanical drawings. These are cut into the stone, just as they would be into metal, by using a dry point. Stone engravings are rather hard to print, though they can be readily transferred on to a flat stone surface, and printed like other lithographic work. Stone engraving cannot be made as fine as metal engraving, though excellent work of certain kinds can thus be done.

We have now presented a synopsis of the chief modes of engraving, though some other processes have been tried which might have been added. Specimens in the various styles described are exhibited in the Crystal Palace, some of which are highly honorable to art and to their authors. They are distributed throughout the building, and in a great variety of forms, from the gigantic ordnance maps to "The Homes of American Authors." Specific criticism, even though it were our object, would be in great part baffled by the lack of salient subjects, on which to concentrate attention. In matters so directly addressed to the eye as engravings are, the critic will hardly make the spectator see more or less than he would of his own accord. But the processes on which we have dwelt, are not thus obvious to the senses, and this synopsis may therefore be of service in giving desired information, and of thus contributing a new element of interest.

ORNAMENTAL FURNITURE.

FURNITURE is made to be used; or, perhaps it were better to say that it should be made for use. A couch upon which yon cannot lie, a table from which you cannot eat, a chair upon which you cannot sit, might better not be made at all. No matter what their richness of material, their beauty of form, or exquisiteness of workmanship, such articles cumber instead of furnishing the place in which they are. The most comfortable chair or bed is the best; and so the most convenient table, or wardrobe, or writing desk is the best, and, in the highest sense, the most beautiful; for it will have a beauty of fitness, the lack of which is utterly fatal to the enjoyment of any other beauty. Let the form of a couch be essentially inconsistent with the idea of repose, and if it were covered with carving by Buhl or Grinlin Gibbons, it would, *as a couch*, not be beautiful; because the mind of the thoughtful observer, he who can justly appreciate beauty, would be filled with dissatisfaction and annoyance at the incongruity of the design of the object with the purpose for which it was intended; to say nothing of his ever present consciousness of the individual discomfort which would certainly ensue if he were himself compelled to prove, in his own proper person, the fitness of the thing. Usefulness, therefore, fitness, or, in other words, the combination of convenience, ease, and propriety, is the first and highest qualification of furniture, as well as of every other object, the chief function of which is not to give pleasure to the mind through the eye. Beauty of form is of secondary importance; but so far is it from being inconsistent with the first, that it will invariably be found that those designs which are most beautiful in furniture, are those which are best adapted to the uses to which the various articles included in that term are to be put. Elaborate workmanship and sumptuous materials are severally of third and fourth rate consequence. The former, indeed, may degrade a beautiful design by belittling it with painfully wrought trivialities; and the latter, by its unsuitableness, may fail to awaken that feeling of content and freedom from care which is the first office of every article of household use. Added to these requirements, there is a certain harmony of place, if we may so call it, which has much to do with the power of furniture to awaken ideas of comfort and pleasure. An intrinsically beautiful article may be a pleasant object in one place, and in another, unpleasant and ridiculous. A chair, for instance, which, standing in Westminster Abbey for the use of the Archbishop of Canterbury, would be imposing, and from its harmony with the place, would awaken a feeling of admiration tinged with solemnity, if transferred to the boudoir of his Grace's daughter, would excite only our ridicule, mingled perhaps with a little of the terror which would be felt in a nursery upon the entrance of a very magnificent giant. So a buffet, well suited to the hall of a Norman Castle, or English Manor-house, would only overwhelm and crush all its surroundings if transferred to a 'third room' on the Fifth Avenue. These, then, in their order of importance, are the considerations which should influence the selection of furniture, and which will guide us in a brief examination of such ancient and modern examples as will afford a comprehensive view of the subject from the earliest ages to the present day:—fitness of form, beauty of outline, design and finish of ornament, richness of material, and, as kindred with the first, and of equal importance with beauty of outline, though not having to do with intrinsic fitness or beauty,—adaptation to place.

It would be a difficult, and by no means a profitable task to inquire when furniture first was used. Chairs probably came into vogue about the time when people first began to sit down. Indeed, it is safe to assume that Adam chose carefully two of the softest stones in Paradise for the use of himself and Eve, and that in them we are to acknowledge the primitive type of the chair. We name the chair first, because its accommodation is that which nature first demands; and, indeed, according to the Monboddian theory, this article of furniture has greatly modified the external appearance and even the destinies of mankind. For if man be only a monkey whose tail has been worn off by constant sitting, the chair may certainly be regarded as the proximate cause of the existence of the human species—as such. Tables, without a doubt, soon followed chairs as a support for food. Milton is the source of much of the orthodox theology of the day: why may he not be admitted as authority upon all the subjects of which he sang? He assures us that both tables and chairs formed a part of Eve's establishment in Eden. When she entertained Raphael in her "sylvan lodge with flowerets deck'd and fragrant smells," Milton, with praiseworthy particularity, tells us,

> "Raised of grassie terf,
> Thir Table was, and mossie seats had round."

The form, it seems, was quadrilateral; for the poet continues:

> "And on her ample Square from side to side
> All *Autumn* pil'd; though *Spring* and *Autumn* here
> Danc'd hand in hand."

A square is not the best shape for a table, neither is grassy turf a suitable material for the support of hot soup or beefsteak fresh from the coals. Of this unfitness of Eve's furniture for modern uses, Milton seems to have been fully conscious; for, with his usual keen eye to creature comforts, he adds,

> "A while discourse they hold;
> *No fear lest Dinner coole;* when thus began
> Our Anthour. Heav'nly stranger, please to taste," &c.

The forms of household furniture have not changed so much as most persons, perhaps, suppose; in fact, in their principal outlines and essential parts, articles of daily household use could not, and need not vary in different ages of the world. Whether men live in tents or houses, in castles or cottages, whether they be peaceful or warlike, savage or civilised, their chairs, tables, beds, and such like articles, if they have them at all, will be alike in all essential points. The laws of mechanics, the structure of the body, and the ingenuity of the species ensure this. We do not know what were the forms of the bed, the table, the stool and the candlestick, which the good Shunamite woman placed in the little chamber which she persuaded her husband to build on the wall for Elisha; but we do know that the earliest chairs with the designs of which ancient monuments have made us acquainted, had a seat, a back, and four legs; and ours have neither more nor less. The tables of the same period had tops and legs; the former of various shapes, the latter of various number and position, just as is the case with tables of to-day; and so with beds, couches, and other articles. The difference between the furniture of one age and country, and that of another, is merely a difference in comfort and style of ornament.

We go to the Egyptians for the origin of every art and science, and are rarely disappointed; and from the dearth of works upon furniture, being driven to original investigation upon this subject, we find that at an early day in their history, their artisans had arrived at a high pitch of excellence in the manufacture of ornamental furniture. Their merit is not comparative, but positive; and there was for thousands of years very little real improvement upon their models and workmanship, and as might be expected, no more lavish expenditure for costly materials than was common among the upper classes of that strange people. Champollion Figeac, in his work on Ancient Egypt, furnishes us with some direct information with regard to Egyptian furniture; and from the illustrations which accompany it, in which kings and nobles frequently appear in various public and domestic acts and ceremonies, and which are taken from the ancient monuments of the Egyptians themselves, we are able to learn much more that is interesting and instructive upon the subject.

The furniture of the Egyptians exhibits a higher appreciation of the beautiful than we find in any of their works of pure art. The sombre, formal, ponderous taste of the people appears, it is true, even in their tables, chairs, and bedsteads; but it is more modified by graceful motives than it seems to have been in any other of their articles of luxury. It is true, they had not the English notion of comfort, and had not quite attained to *tête-à-têtes* or reclining chairs; but they studied a sort of rectangular ease, and added to their richness of material and elaborate workmanship, a solemn elegance which was at least a substitute for grace. The forms which they affected were grotesque enough. Their couches were frequently in the shape of a sphinx, a lion, a jackal, or a bull,—standing, of course, on all fours. The upward curve of the head of the animal served for the support of the pillow, and a mattress was laid upon the back. The imitation of the beast was carried so far in these singular pieces of furniture, that, in addition to color, gold and enamel were freely used in their adornment. The same labor and rich materials were expended upon their bedsteads, footstools, divans, canopied seats, armories, buffets, chests and coffers; for all these articles were included among their household furniture. Their arm-chairs were supported by legs in the shape of those of beasts, the fore legs and hind legs of the chair corresponding in shape and position to the corresponding members of the animal; which has the effect of making the piece seem as if it were about to walk off by itself. The backs were quite straight upon the outside, and very little inclined upon the inside: at the top they turned outward in a scroll. They were richly adorned with sculpres of religious or historical subjects; and the seats were generally supported, in appearance, on the heads of figures of the shepherd kings, which were placed in this position as a symbol of the servitude of the race; and which, in all the specimens which we have examined, are bound by the wrists and tied together by the neck. The chairs were upholstered with the richest stuffs. Some of their chairs and stools were constructed in the curule form; that is, with the legs crossing each other, and confined in the middle by a pivot upon which they revolved, enabling the chair to be folded up. These legs were sometimes in the form of swan's necks, which were placed with their heads down. Cedar was the favorite wood with the Egyptians for cabinet purposes; it was generally inlaid with ivory and ebony. The seats of even the finest chairs were sometimes made of rushes; but the luxurious covered them with cushions, or soft, rich stuffs. Egyptian bedsteads were not always in the menagerie style; and when they were not, their form is that of an elegant modern couch, without a footboard. The legs, however, have always the shape and position of the fore and hind legs of beasts; and as the foot of the bed is supported by the fore legs of the animal, we know that three thousand years ago it was the custom to place the head of the bed against the wall, just as it is now. The preposterous fashion of high bedsteads, those huge platforms upon which it is necessary to clamber at peril of one's neck, and which went out about five and twenty years ago, existed among the Egyptians; for we find among the pictures which the care of Champollion has preserved, representations of bedsteads which are ascended by four steps; about the number up which our fathers and mothers toiled to their repose—repose which they must surely have

enjoyed; for Solomon tells us that "the sleep of a laboring man is sweet, whether he eat little or much." They had centre-tables in Thebes; and the form thereof was like unto those marble receptacles of costly rubbish which cumbered the drawing rooms and 'best parlors' of England and America fifteen years ago.

In every point, except richness of material and fine workmanship, we of the present day, as well as the Greeks, Etruscans, and Romans, have improved upon the ornamental furniture of the Egyptians. Their forms, from their generally heavy and rectilinear character, were not suggestive of ease, or even comfort; and what they did not promise to the eye they did not give to the body. The Theban had no middle choice between sitting bolt upright, with legs and back perpendicular, thighs at right angles, and hands upon his knees, like a little Memnon, and reclining at full length on the back of some beast of prey. The social intercourse indicated by the Egyptian furniture is one of a magnificent formality, which, judged by modern notions, must have vibrated continually between the solemn and the grotesque.

The remains of Etruscan art prove that the same exquisite perception of beauty of form, which is seen in their vases and paintings, directed the manufacture of all articles for their household use. The chair commonly used in Etruria more than two thousand years ago, is the most convenient and graceful which has been invented. Except the plane of the seat, it was composed entirely of curved lines. The legs curved gently from each other, tapering gradually to the lower extremity: the back had two curves, one slightly from the perpendicular and backwards, the other quite marked in the support for the back of the sitter, which in fact was a segment of a cylinder about four feet in diameter and nine inches high. There is no carving or adventitious ornament at all upon any representation of these chairs which we have seen. Chairs, very like those of the Etruscans, were in fashion about twenty or twenty-five years ago, and may be still seen in the houses of some of those who have the taste, the love of home associations, and the courage not to discard old household friends at the capricious behest of fashion.

The Etruscan bedsteads were shaped like our old-fashioned straight-backed and sided sofas. The dinner bed was like a low table, supported by six feet, pyramidal in form, and standing on a truncated apex, which itself rests upon a plinth. The wood-work exhibits no ornament, except a projecting cornice. Couches were in form very like those used at the present day; low, without back, head or foot-board, and rising at the head in a gentle, sweeping curve. All these were luxuriously cushioned and provided with large pillows covered with rich stuff. The pillows seem to have been always doubled for use.

The Greek furniture was almost identical in form with that of the Etruscans; and the Romans followed the Greeks in this respect, as in almost all others of a similar nature. The beds used both in Greece and Rome were shaped either like the square sofa, or the couch without back or sides of modern days. They were made of ebony, citron-wood, ivory, and even silver, ornamented with inlaid work, and *bassi relievi;* and those in silver had onyx feet. Chairs of the Etruscan form, and also of the Egyptian pattern slightly modified, were used by them; but it is worthy of notice, that when the legs of chair or couch were modelled after those of beasts, the feet were turned from each other; the grotesque, ambulatory effect produced by the natural arrangement being thus avoided. The buffets and cupboards used by the Grecks and Romans were of the simplest possible design, and can scarcely be considered under the head of ornamental furniture, as they were little more than plain shelved boxes or stands for the display or preservation of silver. Their tables appear to have been used only for the purpose of eating. They were of all forms; square, oblong, circular, oval, and triangular. The ornament upon them consisted only of a graceful and finely carved cornice, and legs sometimes straight and fluted, sometimes curved and smooth, but almost invariably terminating with the foot of a beast. Frequently the leg after curving gently in from the claw or foot, curved out again; and from the swell rose the bust of a sphynx or a harpy, upon the head of which the slab rested. The table was sometimes made entirely of marble, ivory, or silver, inlaid with plates of gold. The cornice appears to have been the only carved ornament, except that upon the legs; which in tables, chairs, beds and couches, were with rare exceptions modelled, somewhat at least, upon the forms of those of beasts.

The introduction of that architecture which we call Gothic, effected an entire change in the forms of all articles of household use. What was inside of the house conformed to that which was outside of it. Lightness and grace of design gave place to ponderous angularity; and the imagination of the decorative artist was directed to ornament, which displayed the fruits of an exuberant fancy, rather than to outline; for in that he servilely copied the designs of the architect, or repeated them with various combinations. To trace the changes in the fashion of furniture from the dark ages to the time of Louis XIV., would be merely to follow a repetition in wood of the variations in the style of working in stone. Even this would be interesting to the student who has made this department of art his speciality; but we shall not be tempted into such detail.

Until the eleventh century, the furniture of the nations who had replaced the Romans, the Gauls and the Britons, was of the rudest and simplest description, as far as comfort and beauty were concerned. The only difference which there could have been between the household furniture of a king and a peasant, was a difference either in essential material, or that produced by the addition of precious metals and stones for mere ornament; for when a king's bed was but a clumsy shelf in a clumsy box, and his chair of like construction, the serf, if he had either bed or chair, could not have had them of ruder form. The truth is, however, that the serf did not have them; and that until the eleventh century, the chairs of noblemen were but square settles, made easy by cushions and robes, their tables but boards laid on tressles, and their beds but square boxes on legs, having frequently a canopy over head and sometimes hangings, the richness of which was in strange contrast to the coarseness of the article which they overshadowed. Nevertheless, the furniture of public places, massive and rude though it was, displayed some attempt at ornament, which generally took the form of the heads and feet of birds and beasts grotesquely distorted. Some of the articles were made valuable, though not beautiful, by the addition of gold, silver, and precious stones.

The Anglo-Saxons occasionally used round tables which were supported on three curved legs, somewhat in the form of an S, though much less bent, the foot being that of some beast, and the slab of the table resting upon a grim and rudely carved head. These tables are quite like those used by the Romans, which we have already referred to, the double carved legs of which terminated above in the bust of a sphinx or harpy. It is not improbable that the form may have been adopted by the Anglo-Saxons from relics of the furniture of the previous conquerors of Britain. The cupboards and buffets of this time were too rude to present the slightest claim to a place among ornamental furniture.

In the tenth century the massive, rectangular furniture began to be ornamented with panel work, and the chairs to be lightened by the introduction of balustrades into the back and arms;—a fashion which still obtains; but although carving in architectural forms was now rapidly introduced, there was no change for the better in design or comfort. Not only are the specimens of furniture which have come down to us from the 12th, 13th, 14th, and 15th centuries, and which are, naturally, those preserved in public places,—not only are these ponderous and uninviting, as might be expected, but the articles represented in the domestic scenes of the illuminated manuscripts of the period, seem contrived with malice prepense to ensure the greatest possible amount of inconvenience and discomfort to their possessors and occupants. Beds, couches and chairs, when stripped of the extraneous ornamental carving, are but heavy, clumsy, oaken boards, put together at right angles. It is so painful to see old saints sitting, and sick saints reclining upon these instruments of torture, that, as we look, we wonder that a belief in purgatory could have obtained general credence at a time in which even those who lived and died in the odor of sanctity were obliged to undergo such daily suffering.

But as refinement advanced, articles of household convenience were multiplied for all classes; and although the forms continued to be forbidding, owing to the inexorable perpendicularity of the genius of Gothic architecture, which, as we have said, entirely controlled the designs for furniture in the middle ages, still, much was done by adventitious means to make sitting and reclining less exquisite in their torture.

A new sentiment began to manifest itself in the furniture of this period—that of domesticity. The furniture of the Egyptians, Etruscans, Grecks, and Romans is evidently not that of a people who found their greatest happiness in social enjoyment, not to say, in the intercourse of home. Their beds, chairs, couches, and tables were barely sufficient for the actual and inevitable demands of nature; and, though elegant in form, they do not seem the better fitted to add to the simple enjoyments which form the staple of domestic happiness in every rank of life. The Theban, the Athenian, and the Roman sought pleasure in public, and generally in the open air. We have yet to see among those elegant apartments represented upon the monuments of classic antiquity, a single one which has what we call a habitable look. The contrary is the case with the views of interior life afforded by the emblazoned pages of Christian antiquity, where, especially in such as are of English origin, we see that the rooms and the furniture are those of a people to whom domestic life had an importance and afforded a pleasure unknown to the citizens of Greece and Rome.

The bed now became an article of the first household consequence. The bedstead and the couch were no longer convertible terms or things. The latter, standing in the more public part of the house, was open to the use of any one at any time, but the former was removed into the most private apartments, and was used only for the habitual repose of the members of the family. Bed linen came into vogue, and the bedstead, as it was to be stationary, conformed completely to the ponderous taste of the times, and assumed such vast proportions, and such solidity of structure, that only the force of some huge engine, the rude hand of war, or a convulsion of nature could remove it. The curtains, which seem to be of Anglo-Saxon origin, demanded support; and they had it in the shape of four huge, elaborately carved wooden pillars, which sustained a stupendous framework called a tester, bearing about such resemblance to the modern article of that name as *Falstaff* did to the mannikin page given him by *Prince Hal.* These testers had carved roofs; and the headboards of the bed, shaped like a Gothic arch, were marvels of intricate carved work, the centre of which was frequently the armorial bearings of the person at whose cost the structure was elevated. Shakespeare makes *Sir*

Toby Belch allude to one of those formidable sleeping machines. He says to *Sir Andrew Aguecheek*, when urging that valiant gentleman to challenge *Viola*, "and as many lies as will lie in thy sheet of paper, although the sheet were big enough for the bed of Ware in England, set 'em down." We obtain a definite idea of the degree of freedom in giving the lie which *Sir Toby* recommends to his pupil, when we learn that this bed was ten feet nine inches long, by ten feet nine inches broad; and the question naturally arises whether Shakespeare did not allude to it more than once, and whether, as it stood, we believe, in an inn, some of its remote and unexplored recesses did not contain "the undiscovered country from whose bourne no traveller returns." Indeed it would be a tempting of fate to commit oneself rashly in the night to such a wide waste, without some kind Ariadne to furnish a clue by which to find the way out again in the morning. This famous bed may be regarded as the ideal English four-poster. It was ceiled with heavy panelling, and its ponderous and elaborately carved cornice was supported at the foot by posts, into the composition of which, pedestals, pillars, and arches entered in the lower half, while the solid upper part was decorated by carved leaves and arabesques of enormous size. The head-board, which reached and supported the cornice, was worthy to be the altar-screen of a cathedral. Among the carvings which adorned it, were three human figures half the size of life, and two elaborate arched panels. This bedstead was planned and constructed in the reign of Queen Elizabeth: the architect's name has not survived.

The buffet, as it exists in our thoughts, had its origin in the middle ages; for the little recesses in the wall, which the Greeks and Romans used for the purpose of keeping gold and silver vessels, cannot be considered even as the germ of those ponderous carved scaffoldings—those cupboards "of five stages height, triangled"—those things "made like stayres to set plate on," upon which our ancestors used to display the family silver. These, at first small, rude, and unornamented, gradually increased in size and richness until they, with their furniture, became the most imposing article in the great hall of castle and manor-house. They were covered with grotesque carving of the most intricate and elaborate kind, and were expected to display "a covered cup of gold, six great standing pots of silver, twenty-four silver bowls with covers, a bason, ewer, and *chasoir* of silver," in addition to such other vessels of metal and glass as the pomp of a great house required on state occasions. They were the results of a hospitality which was both open and ostentatious, and of a social system in which a few great proprietors delighted to display their wealth to their friends and dependents, who themselves took pleasure and pride in the magnificence of him who was their ally or their lord.

Book-cases are of yet more modern origin. When books were multiplied only with the pen, and were rolled upon cylinders, book-cases, in the modern sense of the term, were not needed, and in fact could not be used. The change from the roll to the quadrilateral form first required the use of shelves for the reception of volumes; but even long after this period, books were kept in chests or laid up in racks. Book-cases, as an article of household furniture, did not exist even in modern times, until half a century after the invention of printing; that is, about the beginning of the sixteenth century. When nobles and gentlemen could hardly read or write their names, and in fact thought study quite unsoldierlike and somewhat unmanly, libraries and book-cases formed, of course, no part of their household wealth. When they did come into use, they were constructed upon the Gothic architectural model, which, indeed, in its predominance of perpendicular lines, its tendencies to arched panelling, and its union of a general sobriety of effect with the most fanciful richness of detail, is peculiarly suited to rooms devoted to literature, and quite consistent with the safe and convenient arrangement of books in numbers either great or small. When books were collectively few and individually large, a comparatively small receptacle would hold all which would supply the wants or be within the means of gentlemen of ordinary wealth and devotion to literature. The earlier book-cases were very beautiful pieces of furniture; not too large for a modern parlor, richly carved, having few shelves, and those wide apart for the admission of goodly folios, and usually made with a recess in the middle for the admission of a reading desk, which was sometimes a part of the book-case and sometimes movable. Those who have read the 'light literature' of the early part of the sixteenth century will easily understand why it was desirable that there should be a resting place for the volume very near the shelf from which it was taken. It is quite needless to give a more particular description of these book-cases, which increased in size as each generation added to the collection made by its predecessors. They were, externally, little wooden cathedrals; and a look at a print of the West front of Salisbury, York, Peterborough or Westminster Cathedral, will afford a very just idea of their appearance; if, indeed, any of our readers should not have seen one or more of the innumerable imitations of them, in which modern fashion commands that a certain quantity of gilded morocco must solemnly repose.

It was not until the reign of Louis XIV., that a style of decoration peculiar to furniture came into vogue. With the stately splendor of the court life of Paris at that time, there arose a demand for a corresponding and sympathetic splendor in the surroundings of those who then lived in 'society,'—a something which, as distinct from either domestic life, social enjoyment, or state ceremonial, then first came into existence. Man's mental resources are always equal to his demands upon them: invention can never be exhausted; and in this case an entirely new style was created to supply the need for it. It was not a modification of any previous style, or formed by a combination of the characteristics of any others. It did not put books into cathedrals, or make men sit upon sphinxes or lie upon the backs of ferocious quadrupeds. It had no more affinity with the simple elegance of the Greek or Etruscan style, which was suited to apartments and to a state of society which needed but a little furniture, than it had with the ponderous and fanciful richness of the Gothic, which was made for a people who literally inhabited their rooms, and easily acquired a love for the mere insensible objects with which they associated the idea of home. The Roman, in his bare, unfurnished house, must needs have his Lares; but the household gods of the Norman, the Teuton, the Scandinavian, and the Anglo-Saxon, were the table around which his kindred sat, the cradle over which his mother bent, the bed on which his father died.

The world, in its new phase, worshipped neither sort of home divinity. It had but one God—Louis, but one religion—fashion, but one ceremonial—society. The change in furniture which it called into existence extended to every article of daily use; it penetrated the inmost recesses of the house; in fact, it supposed no privacy, and had no need to do so; for then, even the morning toilet, as well of ladies as of gentlemen, was, from its very commencement, a 'reception.'

The characteristics of the new style were studied grace, exquisite finish of detail, and the greatest possible display of richness of material. The forms were entirely new, and were produced by ever varying combinations of curved lines, which conformed to no type in nature, but, on the contrary, expressed artificiality and courted admiration in every bend. To mere curved lines producing circles, ovals, ellipses, and nameless figures resulting from the capricious interference of these with each other, were added scrolls, shells, masks, and garlands, which were placed without the least reference to the natural fitness of the object for its position; the idea suggested by the combination being solely that of ornament for the sake of ornament. The materials used were the rarest wood, and even ivory; and these were inlaid and gilded into the utmost extreme of gorgeousness. The aim of the designer appeared to be to attain at once the richest and most fanciful combination of color, outline, and varied surface, and the most striking contrasts of material. At this time Buhl, the King's cabinet-maker, invented the well-known incrusted metal-work which bears his name, and which is made at this day, with little variation from his style and as little improvement upon his manufacture.

As we have before remarked, this was the first purely decorative style in the history of furniture. If imitation be the essential motive of all Fine Art, much of the Egyptian, Etruscan, Greek, and Roman furniture might properly claim a place in Sculpture; and the same definition would entirely exclude the new style from all consideration due to it on the score of Art, for it suggested no idea but that of furniture and decoration,—and decoration for decoration's sake. But the inventors of the novel ornamental forms given to all furniture at this time, although entirely free from the restraints of imitative Art, and at liberty to adapt their designs strictly to the uses to which the articles embodying them were to be put, obtained complete success only in one direction; but it must, in strict justice, be added, that that direction was the one to which alone their efforts tended. They obtained an original, rich, peculiar, and highly ornamental style; one suited to the social splendor of the day; and this was a perfect and a great success. But although they made some improvement upon the perpendicular, rectangular forms of immediately preceding ages, they made only a partial advance in comfort, or the appearance of it, and frequently reached some of their most fanciful and splendid effects at the expense of radical faults of construction;—that is, the forms which they chose were not adapted to the purpose for which the article was intended, or to the material from which it was made. For instance, it was not uncommon for them to make an arm-chair in which it would be impossible to recline with ease, and the wood work of which was carved with such disregard of the course of the fibre, that had any body reclined in it, back, arms, and legs must have inevitably snapped like pipe-stems. The cabinet-makers of that day needed a course of study upon Mechanics and the Strength of Materials.

But this, too, was thoroughly in keeping with the spirit of the time. People did not live for home comfort then: they lived for 'society,' and society was a continual drawing-room. Ease then was either a comparative or a conventional term, and meant, to seem as much at ease as possible under adverse circumstances. Buhl, when he made an arm-chair for a Marquis, knew that the rich back would never be touched, that the beautiful arms would be used only to hold up and display yet more beautiful arms of another kind, and that the dainty formality with which the sky-blue satin breeches of some courtier might be deposited upon the extreme front of its seat would not test the capacity of its curiously formed legs to sustain a weight. Therefore the furniture of this age is expressive not of comfort or luxurious ease, but of disciplined constraint and luxurious ceremony, not of ostentatious hospitality, but of empty ostentation. But in the creation of a purely decorative style, it made a great stride in advance, and commenced in

France a reform in household art, the influence of which is yet felt throughout the world; for it is almost needless to say that at that day France ruled the world of fashion with a sway yet more despotic than that which she exercises now, and that her dictates were deemed no less binding upon furniture than upon dress;—far more so, indeed, than they are at present; for your Englishman of to-day thinks scorn of French 'flimsiness,' except in articles which are by nature flimsy.

The succeeding age, after the manner of succeeding ages, only exaggerated the style of its predecessor. But who needs to be told that the reign of Louis Quinze perpetuated all that was weak, all that was vicious in that of Louis Quatorze, while it threw off the stately formality and external propriety which lent to that a semblance of respectability. This change was completely reflected in the furniture of the period, in which all was done that an extravagant and licentious fancy could do, to pervert and fritter away whatever was meritorious in the style which had been bequeathed to it. The result was the elaborately absurd mannerism known as *rococo*.

The next change was to as great an absurdity of a different kind. The Revolution and the Empire brought in an affectation of the classic; and the effect upon furniture was the production of ponderous and frigid monstrosities. As, in every thing else, so in household decoration, the only end attained was caricature without humor, travestie without fun. The solemn affectation of Greek and Roman forms was so ridiculous, that only the inherent vitality and grand simplicity of the classic motives enabled them to survive "the deep damnation of this *taking off;*" otherwise the very name, classic, would have provoked a smile. In the furniture of this day we find cornices which are movable, pillars and pilasters supporting nothing and swinging upon hinges, and arches upon which nothing rests, and the only keys of which are the keys which unlock them that they may fall forward in the shape of desks and tables. Decorative furniture owes to this age only the introduction of the beautiful Etruscan Greek chair, which we have before described; and the severe, essential simplicity of which, while it, with a semblance of reason, may exclude the chair, in the estimation of some, from ornamental furniture, also preserved it from perversion and degradation at the hands of the second-hand Greeks and Romans of Anno Domini 1800.

At the present day we are, in furniture, as in the arts and all the mechanical pursuits depending on them, more or less eclectic. But we sometimes wear our rne with a difference, and when we do, that difference is sometimes on the side of comfort and convenience. In fact we have a furniture style of our own, which, though not original, bears yet the marks of our utilitarian age. It is a modification and a moderation of the style of Louis XIV.; and while it assumes the graceful motives of that style, it also reduces them to greater simplicity, and moulds them into forms more consistent with comfort and constructive truth. This style appears chiefly in chairs of all kinds and in sofas, and will readily recur to those at all observant upon the subject. The only specimen of it which we have engraved, is the sofa on page 191, exhibited by Alexander Roux; and in this, much of the carving upon the back is more than superfluous. The projections made by it, form surfaces very uninviting to human shoulders.

Most of the furniture in the Exhibition is of American manufacture; and the display may be taken as a fair index of the taste and judgment which we exercise in providing ourselves with household comfort and ornament. It must be admitted that the conclusions forced upon us are not at all in favor of our good sense or our perceptions of beauty or fitness. The article exhibited in excess is the buffet; the very one which is least suited to our means, our habits, and our style of living. There are not a hundred private houses in New-York with a dining room large enough for a buffet; and certainly not that number the owners of which can afford to live in the style in which a man should live who has a buffet properly covered. And even in the few cases in which this is not true, in how few of these can the sons look forward to the possession of the buffet when the father is obliged to leave his splendor? and how many a daughter goes portionless from that splendor, and because of that splendor, to the home of a young husband who has just struggled into competence? Now, this is all wrong. That buffet does not fulfil its office. It does not make us feel the more welcome, or the more at ease while getting through the sumptuous and elaborate hospitality of our host. On the contrary, it is quite uncomfortable to think that our entertainer and his family have little more than a usufruct interest in that splendid combination of carved wood and plate. It interferes with the digestion of ortolans, and deadens the bouquet of Lafitte, to reflect that our munificent friend's eldest son,—the young gentleman whose amiable weakness at the knees attracted our attention as he entered the drawing-room, if, according to an elegant phrase which he sometimes uses, the governor should take it into his head to pop off some day,—that then this tender-hearted youth would have his feelings lacerated by the sight of the buffet and its plate under the hammer of the auctioneer. But, suggests some apologetic philanthropist, the cost of a buffet is not much to a moderately rich man, and many people have a buffet without plate. So they do, preposterous fools! and they might as well have a stable without horses, a table without food, a library without books, or books without brains. A buffet requires a large dining-room and a respectable display of plate; which requires a large and sumptuously furnished house; which requires a corresponding equipage and retinue of servants; and the comfortable enjoyment of these requires a consciousness that they will not all vanish into thin air at the death of one man. Consider the eternal fitness of things, good people, and banish your buffets in favor of the more modest sideboard; which, nevertheless can be made sufficiently beautiful and sufficiently costly to be a becoming decoration for any dining-room.

With regard to the specimens of buffets in the Exhibition, we have little to add to what has been said in introducing the engravings of the most important of them. They are generally well designed and appropriately decorated; and the carving upon some of them claims high consideration as art. This is particularly the case with that represented upon page 114, exhibited by Augustus Eliaers, of Boston, and which, although called a side-board, is actually a buffet, and with that upon page 168, exhibited by Messrs. Bulkley & Herter, of New-York. The former is comparatively modest in size, and though rich, is unimpeachably chaste in its decoration, and has a symmetry of outline which charms the eye. It has but one fault. The beautifully designed carved work upon it appears to have been rubbed smooth. This finish is a blemish. No elaboration of surface can compensate for the loss of the spirited touches of the carver's tool. The second is really a noble work—not only large in size, but grand in style; and in the sharp lines and rich surfaces of its carved work it shows the peculiar beauty which disappears under the hand of the polisher. But it is only fit for the dining-hall of a castle or a manor-house.

The chairs exhibited, call for very little remark: they are generally neither very good nor very bad. But one, which is represented on page 166, is worthy of notice as being almost the ideal of inappropriateness and discomfort. Its elaborate and finely executed carving only renders it the more unfit for any place in which an easy chair should be admitted; and the style of its decorations, though very well for the façade of an arsenal, is preposterous in the chamber, the drawing-room, or the library, where grim-visaged war should smooth his wrinkled front.

Of tables, our pages exhibit three monstrosities and one fine model. Among the first is that exhibited on page 65, which in outline and in decoration is at war alike with the principles of construction and of good taste. The legs seem, and are, utterly worthless as supports; and the figures with which they are adorned only tempt to the best disposition that could be made of them,—to break them off. The console table on page 125, and the centre table on page 175, are not much better. The former is deliberately designed to be as useless as possible; and looks more like the skeleton of some antediluvian insect than a piece of household furniture. The centre table exhibits a world of talent—and of rosewood, thrown away. The carving is very fine, but what of that? The thing outricocos *ricoco*. Here are caryatides with their heads rising above that which they support, and other caryatides which are actually supported by that which they should support. The form of the legs is such that the whole weight must be sustained by the mere lateral adhesion of the fibre at their smallest diameter, —which with ingenious perversity is placed exactly where the greatest strength is needed,—and that it is impossible to put the thing to any use for which a table is needed. A lady in a hoop might approach it and toss her fan upon it; but there its worth ends as a piece of furniture. The extension table, on page 125, exhibited by C. F. Hobe, is at once elegant, substantial, and useful; and is constructed upon exactly those principles which the other three defy. This is not the fault of the makers of the former, for those were made for show and sale to people of bad or uninstructed taste, while the fourth was made for use.

We have engraved only two bookcases; but these will amply serve the purpose of illustrating our views. The first object of a bookcase is the protection of books; but this would be fully attained by keeping them in a chest or a cabinet. There, however, access to them would be difficult, and so we place them upon shelves for convenience; but we do not use the shelves of a closet because upon those the books would be hid from view, and we should be deprived of that familiar acquaintance with their exterior, which, to most of those who really love books, is one great enjoyment in the possession of them. To the bookish man—not to say to the student or the bibliomaniac, the loving look at a prized volume, and the quiet caress of the appropriate attire with which the binder has clothed it, are a silent grace before intellectual meat. The design of a bookcase is good then, just in so far as it combines protection to books, convenience in their use, and pleasing display of them; and obviously, whatever ornament is added should not only be in harmony with these objects, but entirely subordinate to them: the case should distract attention from its contents. Judged by this standard, the two bookcases represented on pages 67 and 173 have merits and defects. The former, exhibited by Messrs. Bulkley & Herter is a fine specimen of Gothic furniture. Its style and its ornaments are not only beautiful in themselves, but in perfect keeping with the purpose for which the piece is designed. As we have before remarked, there is in the Gothic style a peculiar fitness to bookcases and to library furniture of all kinds. But this bookcase, although it protects the books, and is tolerably well arranged, as far as convenience is concerned, has the serious fault of concealing the greater portion of its contents. It is rather a stately cabinet than a bookcase; and wherever it

stood, itself would be the attraction, rather than the books which it contained. The case represented on p. 173, exhibited by J. Dessoir, obviates this objection almost entirely; and save for its waste of valuable space by the triangular compartments at each end, and the insertion of the impertinent and unmeaning little figures at the spring of the arches, it may be regarded as an entirely successful design, and one much more in harmony with the architecture of city houses than its superbly ornamented rival. In the design and construction of book-cases, the front should contain only so much wood as is necessary to the strength of the jambs, and sash, or door frames; all else is superfluity; no matter how highly and appropriately ornamental it may be in itself. For the same reason, it is better that the doors should be glazed with large than with small panes.

We regret that we have not been able to speak in more general and unqualified praise of the furniture in the Exhibition; and, all the more do we regret it, because of the predominance of American work in this department,—a department in which, from the purely domestic character of our people, and the well known ingenuity and skill of our artisans, it would be reasonable to expect the highest kind of excellence. On the contrary, however, we find only the first grade of an inferior order of merit,—the mere excellence of high finish and elaborate ornament. But, as we have before hinted, buyers, rather than the designers of furniture, are most to blame for this. If the former, disregarding their own instincts, which we know would lead them to choose furniture with reference to its capacity for bestowing comfort and its domestic fitness, deliberately give themselves up to ostentation and inexplicable dumb show, we cannot expect the latter, who live by them, to refuse to minister to their frivolous and degraded taste. It is to the buyers, then, rather than the makers of furniture that our strictures have been addressed; and we have not on that account spoken the less freely or directly, or as some, perhaps, may think,—severely. But if this Record of the World's Industry, and these essays suggested by the exposition of the fruits of that industry, are to have any intrinsic value, any abiding influence, that value and that influence will be largely owing to the out-spoken, independent judgments which make the critical staple of this volume.

The moral of our essay is, in a few words, this: that furniture, ornamental or not, is only excellent just in so far as it is useful: that mere ornament must be left to the Fine Arts, whose peculiar function it is to minister to our sense of beauty: that furniture, however, can be beautiful, and that its highest beauty is entirely consistent with its perfect usefulness. In judging a single piece of furniture, its fitness of form to the purpose for which it is designed must be first determined; next, its mere beauty of outline; then, the design, appropriateness, and finish; and last, the richness of the material which enters into its composition. The general mode of choosing furniture is to reverse this order, and consider first the material, next the ornament, then the beauty of form, and last the fitness. These considerations affect the furniture itself; but the place which is to receive it should influence the judgment as second only to the use to which it is to be put. This style of the house, the room, and all the domestic surroundings should be constantly borne in mind in the choice of furniture. Congruity and harmony should not be violated in a drawing-room, a parlor, or a library, any more than in a picture or a poem. But, though some reference should be had to architectural consistency, still it is not necessary to exclude from a house or a room all furniture the style of which is not contemporaneous with its architecture; and this, because houses are enduring, while furniture is destructible and changing.

There are certain rules, however, which can only be disregarded at the cost of the most ruthless disregard of propriety and violation of good taste; and these have reference to the mingling of different styles both of furniture and architecture. The union of two distinct styles in one piece is an atrocity not the less barbarous because it is common. "The words of Mercury are harsh after the songs of Apollo;" but this is worse, infinitely worse; it is the words of Mercury *with* the songs of Apollo. The introduction of an Etruscan chair or a Roman table into a room of Gothic design, though not always desirable, is justifiable; it violates nothing in the order of time, and neither of the articles is sufficiently imbued with the spirit of classical architecture to take it out of neutral ground; but to bring a Gothic arm-chair, book-case, or table, into a room, the architecture of which is Grecian, is to combine anachronism and discord in the utmost possible degree. The existence of Gothic furniture with Greek or Roman architecture is not to be accounted for by any admissible supposition; and the motives of the one are openly and radically at war with those of the other. This should be ever borne in mind; and, not less,—that the size of furniture should be adapted to the proportions of the apartment for which it is destined.

The object of all articles of household use is to afford bodily ease and pleasurable repose of mind; and therefore, as a parting word, we add, for the benefit of the large majority of those who will read these pages—a majority with which we can heartily fraternize—that the luxurious furniture which will beget content in the house of a rich man, because we know that it is in place, and trouble ourselves no more about it, will only provoke discomfort in a poor man's dwelling, because we feel that there it is out of place, and we involuntarily share the trouble that we know it brings to him.

PORCELAIN AND OTHER CERAMIC MANUFACTURES.

THE display of fine porcelain in the New-York Exhibition, and of objects illustrating several other branches of the ceramic art, is one of the remarkable features of the place, and it is little to say, that it has proved a most novel and instructive spectacle to those who had not before seen the great National Museums of Europe. Fortunately for the development of this art in the United States, the costly experiments, analyses, designs, and processes of the manufacture preliminary to success, have been made at the expense of immense sums of money and of the best scientific and practical skill, by France and other European governments during nearly a century and a half. These results confirmed by the latest experience, are perfectly accessible through the enlightened liberality of those at whose instance they have been made, and are embodied in the well-digested literature of the subject in the most precise terms. It cannot happen but that we shall soon avail ourselves of these facilities to establish on a large scale an industry whose more common results are a matter of daily necessity, although it will be long, before we can produce the costlier and more artistic examples of the art. There is no more perfect embodiment of the refinements of modern art and the triumphs of modern science than we see in a Sèvres vase.

In our studies of the properties of natural products, we have frequently occasion to remark, that nature has provided a substance, whose peculiarities fit it especially for a particular purpose in the economy of human necessities, and that nothing else could replace it in this relation. Such a substance is CLAY or alumina, which, next to silica, is the most abundant mineral constituent of our earth. No productive soil is free from a large portion of it. Alumina, however, forms no part of the ashes of any plant, and is therefore entirely wanting in the organization of all animals. Yet alumina subserves a most important purpose in all fertile soils (albeit, of itself quite sterile and valueless, and when in excess, offering most serious impediments to agriculture), namely, in its power to retain moisture and fertilizing gases, and in giving by its plasticity the requisite degree of adhesion to the other earths, which alone have none of this property. It is the only earth having the valuable property of plasticity or capacity of being kneaded like dough, accompanied by entire absence of elasticity, so that it preserves exactly the impression of the slightest force, and becomes hard upon losing its moisture.

The two chief varieties of clay are porcelain clay and common or potters' clay. The important distinction between these two varieties of the same substance, is in the fact, that porcelain clay is always derived from the decomposition of felspar, and the latter from common aluminous rocks, or non-alkaline minerals. Felspar contains in its unchanged state, a large amount of potash or soda, and in its decomposition parts with nearly all its alkali to form a soluble silicate of potash, which is washed out by the waters, and leaves an insoluble plastic mass of porcelain clay (silicate of alumina). In such a clay the two constituents and the water of combination always associated with them, are very constant, while in common clays they are very variable; and added to them are variable quantities of oxyd of iron, lime, and sand, which seriously modify the fusibility and other properties of the product. In the best porcelain clay the equivalents of alumina are equal to those of silica, and the water of combination is equal to both the other constituents. The idea that porcelain earth contains a notable quantity of alkali, to which the semi-vitrification is due, is a mistake, and it is requisite to add to it a certain portion of the undecomposed alkaline mineral (felspar), in order to secure vitrification in the burning. The simple silicate of alumina (pure clay), is almost incapable of fusion by itself and resists the utmost heat of the finest furnace of the arts, with only a slight softening, and wares made from it are entirely opaque.

Porcelain is distinguished from common earthenware by its beautiful semi-transparency (translucency), as well as by its greater hardness and strength. Our knowledge of porcelain dates only from the discovery of the passage to India, by the Portuguese, who first brought specimens of this ware from China. In China this species of ware has been made from a remote antiquity, and for a long period after its introduction in Europe this was the sole source of supply. It is said that historical records in China prove the existence of this manufacture as early as 2,000 years before the present era, or nearly 4,000 years ago. We are indebted to the researches of the French Jesuits for the first authentic information regarding the materials employed by the Chinese, and their processes of preparation. Specimens of these materials were brought to France under the names of Kaolin and Petuntze. The former substance was found to be a pure clay drained from the decomposition of felspar; the *petuntze*, a quartzose felspar, partly decomposed. These two minerals, both reduced to a state of fine powder, were mixed with water to a paste, and left in large heaps in a damp place for a generation, before they were considered fit for use. It was the custom (and it is still) in China, it is said, for a man to use the clay which his grandfather had prepared, and to prepare at least an equal quantity for future generations.

The known properties of these minerals immediately revealed to the ingenious French the secret of the China ware. The clay alone was able to produce only a white opaque body, like any other good sort of clay ware, but when a proper

portion of the *petuntze* was incorporated with it, the fusible felspar at once imparted new properties to the biscuit, rendering it semi-transparent, and very strong and sonorous. Thus porcelain differs from common earthenware, by being somewhat assimilated to the nature of glass. The felspar fuses in the heat of the furnace, owing to the potash or soda it contains, and the fused portion so completely permeates the whole mass that we may conceive of the clay as being saturated with glass, until it has the peculiarity of semi-transparency belonging to it, as paper is penetrated and made translucent by oil or varnish. Under the microscope the two ingredients are distinguished in the milky mass, the flux or glassy portion seeming to be permeated by white crystalline needles.

Porcelain is also distinguished from common earthenware by its glaze, which is formed of pulverized felspar and has therefore the same composition and hardness with the body of the biscuit. This glaze it will be remarked has no lead in its composition, and thus differs in a most important particular from the glazing of opaque ware. The latter may be removed from the body which it covers by mechanical or chemical means, and often chips off and cracks. No such accident can happen to the porcelain glaze, which, owing to its being of the same constitution with the body of the ware, is completely one with it, and suffers no fracture from any inequality of expansion or contraction between the two materials. It is almost needless to say that porcelain is not liable in the slightest degree to the evils arising from the porosity of common earthenware.

The classification of porcelain and other ceramic manufactures, is conveniently made, as in London, into *a* hard porcelain, *b* statuary, *c* tender porcelain, *d* stoneware glazed and unglazed, *e* earthenware, *f* terra-cotta porcelain, *g* ornamental or decorated.

The mass or body of the ware for hard porcelain is composed as follows:

At Sevres (near Paris).	At Meissen (Saxony), *Called Dresden Ware.*	At Berlin (Prussia).
FOR VESSELS (1853.)	FOR PLATES AND TABLE WARE.	FOR PLATES, DISHES, ETC.
Kaolin, ... 48.	Kaolin (from 3 localities mingled), ... 72.	Kaolin, ... 76.
Sand (separated from the Kaolin above), . . . 48.	Felspar, ... 26.	Felspar, ... 24.
Lime (chalk), ... 4.	Broken Porcelain, . . . 2.	
	FOR ORNAMENTAL PURPOSES.	FOR ORNAMENTAL USE.
	Kaolin, ... 37.	Kaolin from Marl, . . . 25.
	Quartz, ... 37.	" " Beidersee, . 50.
	Lime, ... 17¼.	Felspar, ... 15.
	Broken Porcelain, . . . 8¼.	

It is plain from a glance at this table that hard porcelain is entirely composed of two minerals, both derived from granitic rocks, both very infusible, and forming a compound after the burning, of the most unchangeable nature. The kaolin is rarely found in beds or masses of sufficient purity or uniformity, to admit its being used, without preparation by washing and subsidence in water to separate the undecomposed portions of felspar, quartz, &c. The clay mass for porcelain must be perfectly homogeneous, and very finely ground. This condition is met by first washing the crude material in a series of tubs placed one above the other, and provided with means to keep up agitation by stirring at intervals, between which the coarser matters fall to the bottom, and the finely divided particles of clay flow on with water into the lower vessels, where they subside. The coarser particles, consisting of fragments of felspar and quartz, are then ground under mill-stones to an impalpable powder, and the same process is repeated upon the felspar and broken porcelain, if it is used. The term *slip* is given by the manufacturers to the soft creamy mixture of the finely ground materials with water, having about the consistence of thick cream. This is passed through fine sieves to separate any floating organic matters. It is easy to see, that according as the crude kaolin is clay-like, or sandy and coarse, that the process of washing will furnish more or less of the felspathic and quartzose materials which it is required to add to the kaolin, and hence the practice of every porcelain establishment in the mixing of its several ingredients, must be adapted to the local peculiarities of its own sources of supply for raw material. It is indispensable that the several constituents should be mingled in exact proportions by weight. To effect this with ease, it is usual to employ measured quantities of the slip of each constituent, separately ground, the value of an unit of each having been accurately determined by analysis, and the standard requires the best porcelain to contain in 100 parts; Silica, 58; Alumina, 34.5; Lime, 4.5; and Potash 3.

The paste must always present the same constitution in 100 parts; but as it is a mechanical mixture, it is still liable to separation by gravity into layers of unequal value, in the process of drying. To avoid this, various expedients have been adopted. In France the slip is put in sacks of strong linen cloth, previously soaked in hot linseed oil (which, strange to say, renders them more permeable to water and more durable), and is then submitted to an hydraulic press, as in the expression of flaxseed oil. The paste, by whatever mode dried, is always unevenly so, and is trod out under feet of men, beaten by stamps, and thrown forcibly in balls against an iron plate. Finally, when it is made as homogeneous as possible, the paste made into blocks or balls of moderate size. is stored away in a damp cellar for many months, during which time it undergoes a sort of fermentation, exhales the fetid odor of sulphuretted hydrogen, and blackens on the outside. The beneficial effect of this long storage is universally conceded, but the cause has not been well explained. The clay becomes more plastic, as one good result, and of course works better on the wheel. Porcelain clay, as prepared for use, is never as plastic as potters' clay, and the labor required to produce the same results with it in the wheel, is reckoned as ten times greater than that required when only the pure plastic clay is used. Six hundred plates a day, is a common day's work for a potter in Staffordshire ware, while sixty to eighty are the utmost which can be fashioned in porcelain clay.

All simple circular and cylindrical vessels can be formed upon the wheel by the hands of the potter, aided by a few simple tools; but when the forms are complicated, and especially when they are angular or elliptical, it is requisite to form the paste in moulds of gypsum. The vessels formed on the wheel, after being air-dried, are turned in a lathe in a manner similar to that in use for turning wood.

For the moulds, the clay is prepared by rolling it out upon a table with a rolling-pin into an even sheet, much as a cook prepares pastry. The sheet is made manageable by being spread upon a cloth, and in this way it can be conveniently taken to the mould and adapted to its surface by the pressure of a moist sponge.

The handles, etc., are moulded separately, and attached to the roughened surface by a little *slip*, care being taken that the parts joined have a similar degree of humidity. Open or reticulated work, as in baskets, &c., is produced by cutting away the open space with a knife. Most of the ornamental surfaces are produced in moulds or in the lathe, but stamps may be employed to impress the surface in an ornamental manner, adhesion being prevented between the stamp and the clay by the use of oil of turpentine. The beautiful lace-work so gracefully disposed upon the statuettes of Copeland and Minton, is produced by dipping real lace into the porcelain slip, thus inclosing the fibre, which in the heat of the furnace is completely destroyed, leaving its perfect counterpart in biscuit.

When the several articles are completely formed, they are set away to dry upon shelves in a shady place free from currents of air; no means has been discovered by which the process of air-drying can be hastened without serious injury to the porcelain. When this tedious process is complete, the work is ready to go into the furnace for the first firing.

The porcelain kiln, like all furnaces used for the potters' art, is a reverberatory furnace, but its form and structure are peculiar. It is a circular structure of three stories, separated from each other by low domes of masonry, through which flues admit air for the draught of the furnace and distribution of heat. The structure ends in a conical funnel over the third story, acting as the chimney, where the products of combustion are discharged. The fires are built in four external furnaces equidistant, and at the base of the lower story, and these are so constructed that the cold air is made to pass *downward* through the fire, which is fed with dry wood, (usually pine or poplar), split small and introduced vertically, so that it burns only at its lower extremities, the ash-pit being closed and the air thus made to pass in through the interstices of the fuel. The effect of the disposition of the fire is to prevent the access of cold air to the kiln, to produce a more perfect combustion, and of course more intense and uniform heat. When the furnaces are well served, the combustion is so complete and the current of air so steady and strong, that not a pound of ashes is found in the furnace or kiln, although the quantity of wood consumed would produce over two hundred pounds, burned in the usual manner. A most serious evil is avoided by this absence of ashes, namely, the destruction of the *seggars* or protecting cases in which the ware is packed, which would easily fuse and run together by reason of the combination of the alkali of the ash with the silica of the vessels, endangering the safety of the whole contents of the kiln. The heat passes into the kiln from the furnaces through several small square openings, and then impinges against thick protecting plates of fine clay, which spread and diffuse it equally as possible through the whole of the kiln. The lower story of the kiln receives by far the most intense heat, and therein are placed the things requiring to be baked at the highest temperature, in other words, the ware to be glazed, while the biscuit is fired in the second story of the kiln, which receives its heat entirely from the first; and lastly, in the third story, the protecting cases or *seggars* are baked.

Porcelain, and all delicate ceramic wares, requires to be protected from contact with the ashes and dust of the furnace, by external cases of fireproof sandy clay, made in a cylindrical form, and of such diameter and height as will receive the various vessels, the bottom of one *seggar* or protecting case, forming the top of the one below. The success of a porcelain manufactory may be said to depend upon its being possible to obtain a supply of the requisite material near at hand for forming the *seggars*, whose destruction in each firing is unavoidably considerable, even with the best care and materials, involving of course a large increase of cost chargeable upon the finished ware. Openings are left through the door of each story of the kiln, by means of which, trial pieces (called *watchmen*), can be inserted and withdrawn from time to time, as tests of the progress of the heat. For some hours (8 or 10), after the fires are kindled, the ash-pit is kept open and the heat kept purposely low, that the

whole mass may rise very gradually to a dull redness. The ash-pit is then closed, and the management of the furnaces already described is begun, and the heat raised to the point of incipient fusion of the porcelain (full whiteness), when the flux (felspar,) fuses and vitrifies the glaze. The lesser heat, technically called *warming* (to low redness), drives off all watery vapor and contracts the porcelain, and the baking, which occupies from eight to fifteen hours, fuses the glaze and vitrifies the mass. The porcelain cannot, however, be removed from the furnace under six or eight days, during which the kiln slowly cools, all its openings being closed, and the porcelain thus becomes *annealed* (as is the case with glass), without which precaution, it would be valueless. When the *seggars* are opened, the porcelain, if the whole manufacture has been properly conducted, will have a pure milk-white color, without any tinge of blue, but the surface here and there shows specks or stains which result from the flaking off of small bits from the *seggars*, or from dust and particles of carbon which have found their way into the interior of the *seggars*. While the kiln has been filled below with glazed ware, the second story has in like manner been filled with biscuit, where the temperature is not more than one third as high as it is on the first floor. The shrinkage which porcelain suffers is about thirteen per cent. as a mean for the linear contraction, but the total contraction in volume is near forty per cent. Allowance has, of course, to be made in the modelling for this reduction of size in the baking.

Porcelain Painting is an art closely allied to that of glass painting, the effect being entirely restricted, however, to reflected light, as the semi-opacity of the ware forbids the use of all transparent effects. The pigments are either metallic oxyds themselves, or enamels and glasses, colored by the proper oxyds, and ground to a fine powder. When it is remembered that the desired tints of color appear only after firing, it will be understood that porcelain painting involves artistic difficulties unknown to the miniature painter, whose skill is required to meet the demands of this beautiful art. Many of the pigments produce their appropriate tints only at a certain temperature, far less intense than that of the baking kiln, while others form compounds so fusible with the materials of the glaze, that they would run at a temperature below that required to fuse others. This fact divides the pigments into the easily fusible colors (technically called *muffle* colors, because they require to be fired in an oven or earthenware box, called a *muffle*), and *refractory colors*, or those which will stand the utmost heat of the kiln. The latter may be put on with the glaze or beneath it on the biscuit surface, and do not injure the smoothness, brilliancy, nor hardness of the glaze, while the muffle colors require oxyd of lead to make them act well, and are always elevated above the glazed surface, are sensibly felt as a raised surface, and are more easily worn away. The refractory colors are blue, with cobalt; green, with chrome; brown, with oxyd of iron, oxyd of manganese, and perchromate of iron; yellow with oxyd of titanium, and black with oxyd of uranium; and are all applied with silicate of potash or soda as a flux. Gold is applied to porcelain in the state of fine powder (as it is precipitated by sulphate of iron from its solutions), and is made to adhere by the addition of one tenth of oxyd bismuth, and rubbed up with thick oil or turpentine. The bismuth oxyd fuses to the glaze, and causes the gold to adhere so firmly, that it can be burnished with an agate.

It is in the department of painting and ornamenting porcelain that the most time, talent, and experience are required. Years are lavished on some of the elaborate vases and exquisite pictures of Sèvres, Berlin, and Dresden. And the best artists of modern times have vied with each other in producing cartoons for porcelain painting. Fragility aside, no work of man is more indestructible than a porcelain vase or tablet, and there is every probability that some such memento may go down to future times as an index of the condition of art, refinement, and science, in the nineteenth century; as the Portland vase has survived the splendor and wreck of the Roman Empire, a mute but most eloquent witness of its age.

The Parian statuary biscuit does not differ essentially from porcelain.

Tender or Soft Porcelain.—This differs from hard porcelain in being formed of an easily fusible mass, glazed with lead and borax. In fact, the tender porcelain would be glass, if the materials were treated in the same way. The entire absence of alumina from the composition of the ancient Sèvres tender porcelain, forbids us to consider it as a porcelain. Its composition was in 500 parts: fused nitre, 110; common salt, 36; alum, 18; carbonate of soda, 18; gypsum, 18; sand, 300. This preparation was entirely set aside by the introduction of hard porcelain, and possesses now only an historical interest.

The English porcelain all falls under the head of tender porcelain, if we except some of Mr. Minton's hard porcelain, and the statuettes, which are almost solely an English speciality. The English tender porcelain differs essentially from the ancient Sèvres, and is a true porcelain body made fusible by a flux of bone ashes, but the glaze always contains lead. It is formed by the use of plastic clay, porcelain clay or kaolin (the *cornish stone*, as it is called in England, is only a crude kaolin), burnt bones, chalk, flint, and sometimes soapstone. These materials are ground and suspended in water as already described, for hard porcelain. A *frit* or imperfect glass is formed of a part of these materials, by the addition of carbonate of soda, borax, and oxyd of tin, the latter being added to insure white opacity. The following shows the composition of—

THE FRIT.		THE MASS.	
Cornish Stone,	40	Kaolin,	33
Flint,	28	Blue Clay,	45
Soda,	20	Cornish Stone,	7½
Borax,	7	Flint,	3
Oxyd of Tin,	5	Burnt Bones,	52
		Frit,	7
	100		100

This mass is easily worked, because of the large amount of plastic clay it contains; the goods are fired twice, first for fifty hours, and after dipping in the glaze slip, again for twenty-four to thirty hours. The glaze is usually a silico-borate of lime, soda, and lead, but the lead may be omitted by employing a larger portion of borax, which is sometimes done. This glaze is soft and easily scratched by the knife, but quite smooth and fit for receiving the ordinary painting. The reason why hard porcelain is not made in England, is understood to be the absence of a suitable material for making the *seggars*.

Wedgewood ware is composed of a frit and of a clay composition, and falls more properly under this division than with earthenware. The beautiful forms and graceful ornaments of the Wedgewood ware form a signal instance of the importance of securing the highest talent for design, where an establishment would aim at the best results of which any given art is capable. The English courts present some examples of fictile wares, where the essential principles of design in such matters seem to have been overlooked, and all reference to a subordination of the ornamental work to the use and outline of the whole forgotten. While works of this description, with their exquisite wreaths and bouquets of flowers, and other relievo and undercut ornaments, must excite our admiration for the skill of the artist, and his command over his plastic vehicle of expression, they are inherently unfit for the position they occupy, as is shown by the imperfect manner in which they have sustained the transportation and handling necessary to place them on exhibition. Such ornaments in porcelain are fit only to be placed under a glass shade beside wax, and other artificial flowers, which may be seen, but not handled, qualities which we do *not* seek in a vase or water jug.

It is hardly necessary to point out in the French court the beautiful objects which there attract universal attention. Here again we must refer to the pages where several of these objects are to be seen engraved, and repeat that the productions of Sèvres stand pre-eminent for every quality of taste and excellence of material and manufacture. That Sèvres is an annual expense to the French nation, in a very considerable sum over and above all sales made of its high-priced wares, is only saying that France has been, under all governments, sensible of the duty she owed her arts and artists, to maintain in a liberal spirit a school of design in the ceramic arts, which should be, as it ever has been, a model for the admiration of the world. The best science, and the most distinguished art which the country could furnish, have ever been in requisition for its management. Brongniart's "Les Arts Ceramique," is the great source of information for all subsequent authors upon the history and practice of the ceramic art. Brongniart, for forty years was its manager, and to him and Maleguti (also an employé of the government in the same speciality), we owe nearly all the accurate science we possess in reference to every point of the porcelain manufacture. Ebelman and Regnault have added their services in the same establishment; while in the department of modelling and painting their *artists* have been workmen, and their workmen have had the spirit of artists. Who that has seen the Cupid and Psyche, the entombment of his mistress by a lover, and many other original works in the museum at Sèvres, but must at once feel the power of art to elevate and refine, and admire the union of science and art, which has produced such almost miraculous results.

In the other branches of ceramic art, there is much that might be said with justice and manifest advantage of the beautiful productions of Minton, Copeland, did our space permit as much detail as the subject demands. On another page we present colored illustrations of the encaustic tiles of Mr. Minton. This is the greatest step in decorative architecture, which the ceramic art has made in England, and Mr. Minton has received at all hands the just reward of his eminent merits as a most spirited and tasteful master in his art. The same exhibitor shows striking and most beautiful examples of the old Majolica or Raffaellesque ware, for garden seats, flower vases, &c., for a long time lost or in disuse; and lastly, he has revived the glazed friezes in blue and white, with figures, and other architectural ornaments, known as the Lucca de la Robbia ware, and of which some of the finest examples extant are in Pisa.

We would not overlook the existence of the porcelain manufacture in the United States, as indicated by the specimens shown by the United States Pottery Company, from Bennington, Vt. We do not know why it should be styled "patent flint enamelled ware," as from the specimens of felspar, white quartz, and clay, shown as the raw materials of its manufacture, it is obviously a hard porcelain, of which the raw materials are superior to the skill which has been bestowed on them. The results obtained, however, are very encouraging, and the specimens of white ware sound, and in all respects of most excellent quality.

The group of plate—CHALICES &c., commencing this page, forms part of the church furniture manufactured and exhibited by MM. VILLEMSENS & Co., of Paris. These vessels are made of silver, handsomely wrought and chased, and parcel gilt.

The adjoining FLOWER VASE is accredited to A. BAUMAN, Berne, Switzerland. The delicate imitative sculpture which it exhibits, is executed in white wood. It is a beautiful specimen of carving, and reflects credit upon the ingenuity of the industrious Swiss.

The BUFFET, which completes this page, is exhibited by E. W. HUTCHINS, of New-York. The material is oak, except the top, which is a polished slab of a beautiful variegated marble. The panels of the back are filled with mirrors. The ornaments of the buffet are of the character which custom has prescribed, and which are sanctioned by taste. But we find more to commend in the conception of the design than in its execution. The treatment of the figures in particular is undecided and incorrect, and betrays a want of practical skill in the art of wood sculpture.

The elegant DRESS SWORD here illustrated is exhibited by the AMES MANUFACTURING COMPANY, Chicopee, Mass. It was presented to Col. Thayer, U. S. A., formerly Superintendent of the Military Academy at West Point, by several gentlemen

who graduated under his direction. The vignettes upon the scabbard contain representations of the Academy buildings, and the hilt is terminated with a bust of Calhoun.

The illustrations which fill the remainder of the page represent a selection of the jewelry exhibited by M. RUDOLPHI, of Paris. It would be difficult to praise too highly these exquisite productions. The most delicate and perfect workmanship, and the most artistic and

pleasing invention are here united. The precious metals employed by M. Rudolphi are heap when compared with the value imparted to them by his skill. The Council Medal awarded to M. Rudolphi at the London Exhibition of 1851, shows in what high estimation his talents are held by connoisseurs. One of the articles for which that

award was made is the VINAIGRETTE at the head of this column. It is very beautiful, the clear crystal glass being clasped in a setting of oxydised silver of graceful design and perfect workmanship. The four BRACELETS are also made of oxydised silver, and deserve every

commendation for their artistic merits. The CUP is agate, supported on a silver stem with enamelled clusters of grapes. The small VASE which completes the page is for toilet use, and is very beautifully ornamented with enamels

The honor of reforming the manufacture of jewelry in France, of reviving the mediaeval

processes of enamel and niello, and of giving a

truly artistic direction to the talents of French-

men, is due to the late M. Wagner, the son of a Berlinese goldsmith. In his establishment

M. Rudolphi was *chef d'atelier*, and afterwards associate, and now proprietor.

The beautiful Arm Chair is exhibited by the manufaeturer, Jules Dessoir, of New-York. The wood is black walnut, and the carving is exeeuted with taste and spirit.

A Sofa, elegant in its proportions and highly finished in its workmanship, is exhibited by Alexander Roux, of New-York. The frame is rosewood, and this rieh material is earved with a corresponding riehness. It is upholstered with gaily colored satin.

We engrave one of the exquisite specimens of Beauvais Tapestry, ealled The Skaters, executed by Chevalier after a painting by Lancret. This piece is one of the most attractive of those exhibited; it is valued at 6000 francs.

The engraving with which this page commences represents one of the beautiful Parian statuettes exhibited by COPELAND. The subject is the TEMPTATION OF EVE.

The adjoining bas-relief, executed in plaster, is exhibited by F. W. DANKBERG.

partment, is that introduced upon this page. It is a SOFA, so constructed that it may be arranged, as represented, to occupy the centre of an apartment, or its divisions may be separately placed against the wall. It is surmounted by a massive porcelain vase from which arise the gilt branches of a candelabrum.

Among the numerous articles of elegant and luxurious furniture exhibited by BALNY, Jr., in the French De-

We engrave two ornamental cast-iron PILLARS, which are contributed by the ROYAL IRON FOUNDRY OF BERLIN. The workmanship of these columns exhibits the same exquisite and masterly skill which we have already noticed in terms of high and well deserved praise. The columns were designed by Prof. Strack: the shafts rise

gracefully from their tripod bases, are midway encircled by bas-reliefs of figures from the antique, and their

flat tops supports esquestrian groups, designed by Prof. Fischer. Above the bas-reliefs the dark color of the iron

is relieved and gracefully ornamented by an inlaid thread of silver, wrought into the chaste and simple forms of antique decoration.

As examples of the miscellaneous manufactures of France, we engrave two Cane Heads, very richly and tastefully wrought in gold. They are exhibited by MM. Theodorn & Requedat.

M. La Hoche, of Paris, contributes a great variety of articles in porcelain, glass, and bronze, all of which exhibit the finest workmanship and most graceful decoration. Three examples are introduced on this page—a Candelabrum of bronze gilt, with painted porcelain vignettes; a glass Vase encircled with a gilt vine; and a Flower Vase of glass, the centre being cut crystal, and the top a delicate green, mounted in gilt bronze.

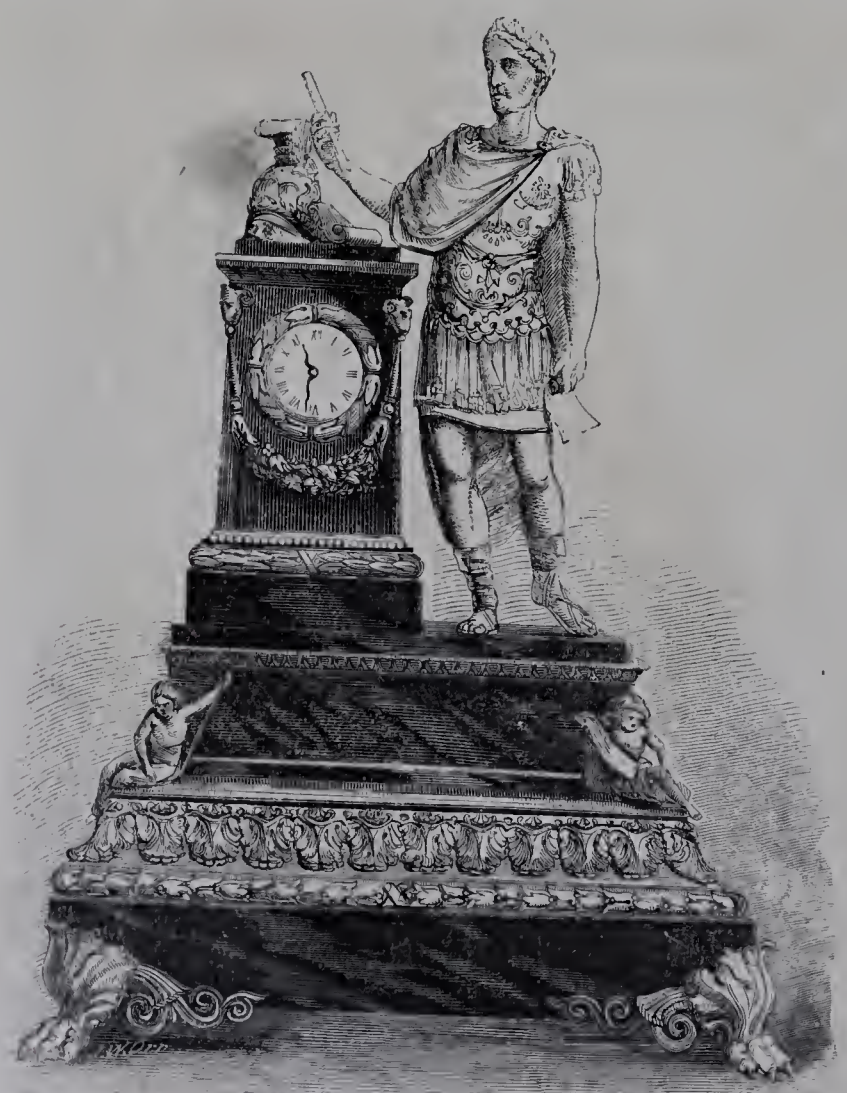
We represent the ornamental part of the Neptune Hose Carriage, of Philadelphia. It is a solid plate of metal richly and beautifully embossed, chased, and gilt.

We engrave upon this page another example of porcelain, the exquisite production of French industry and art. The decoration of this piece presents the richest harmony of colors, and the design is appropriate and beautiful. It forms the top of a small ornamental table mounted in bronze richly gilt. The elevation of the table has already been given in this work. It forms the suitable ornament of a drawing room or boudoir, for the occasional reception of cards and letters, and similar objects of

momentary importance. The table is exhibited by M. La Hoche.

The ornamental Clock beneath, also comes from Paris, and is contributed by Leroll Freres. It is executed in bronze, and is partly gilt.

Messrs. Garrard, of London exhibit the silver Centre Piece here engraved, which



was made by them for Elliot Thayer, Esq., of Boston. The subject is the landing of the Pilgrim Fathers, and the figures represent Captain Miles Standish, Governor Bradford, and the early and faithful friend of the Puritans, the Indian Samoset.

The class of ornamental objects known under the general name of centre pieces, constitutes a very large, and by far the costliest part of the works in the precious metals in the present Exhibition. A careful and continued examination of them has convinced us of their æsthetic and artistic impropriety. Sculpture on a large scale in the precious metals is a mistake; and the attempts at exact imitations of fruits, flowers, and foliage, which so largely abound in the exhibited specimens, are absurdities beneath criticism. The gray and polished appearance of silver, having neither the warm, solid color of bronze, nor the transparency of marble, is altogether unfavorable to the purposes of the artist. Its surface,

whether polished or white, gives false reflections, where in other metals there would be shadows. To obviate this fatal objection to silver as usually treated, the continental artists oxydize its surface even in jewelry, and it then looks like so much zinc. To the uninstructed eye it gives no indication of being silver, and thus in a great measure does away with the value of centre pieces as evidences of wealth and luxury, which,

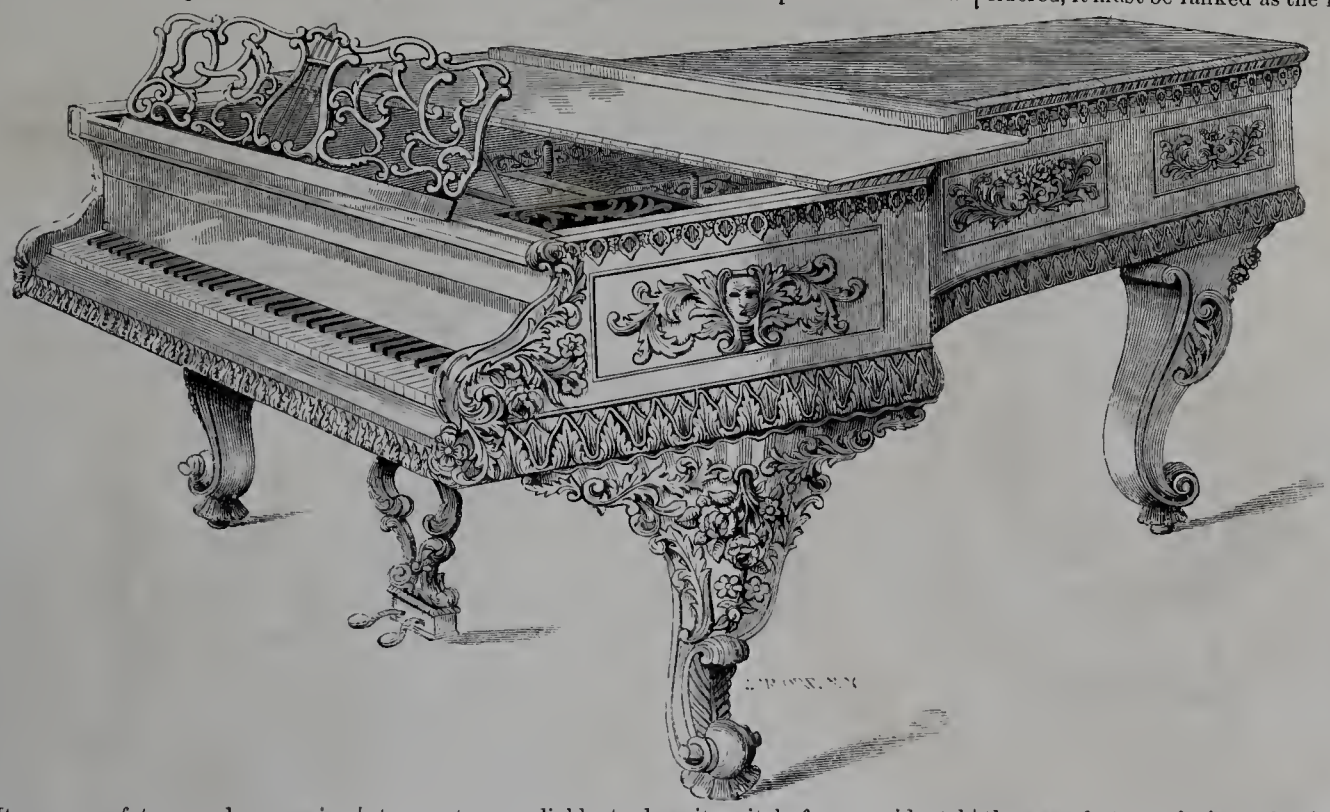
after all, is the true secret cause of their high estimation. There are other ornaments more appropriate for the table on festal occasions, which evince taste as well as luxury on the part of their possessor. Such are the French bronzes, and especially the Sèvres vases, and those exquisite combinations of porcelain and parian exhibited by Messrs. Minton. Let these objects and the centre pieces be placed together, and the bullion value of the silver for the moment forgotten, and, we

believe, that there are few indeed who would not instinctively choose the quiet, harmonious beauty of the bronze and porcelain in preference to the others' pretentious glitter and tinsel magnificence.

The statue of Rebecca is exhibited by Enrico Vasse of Florence.

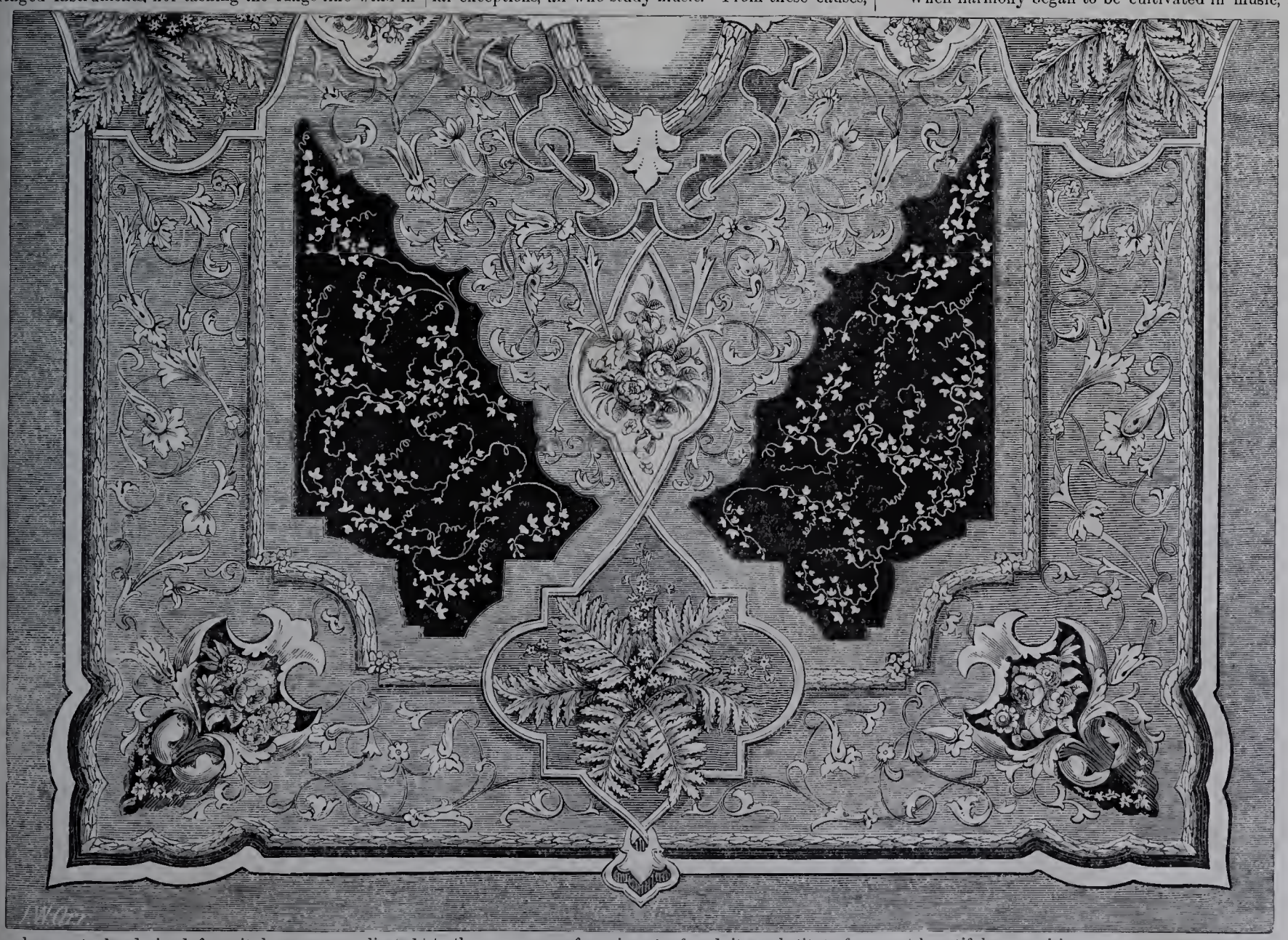
A grand Pianoforte cased in rosewood is exhibited by J. Bassford, of New-York.

We have been unable to obtain any satisfactory statistics of the number and value of the pianofortes manufactured in this country, but from the number of persons engaged in the sale of them, and from the statements of individual makers, it seems to be in a highly prosperous condition. Under whatever aspect the piano is considered, it must be ranked as the first and most important



instrument of music. Its power of tone and expression adapt it to every style of musical composition; it contains an orchestra within itself. It is always ready for use, neither requiring the constant adjustment of other stringed instruments, nor tasking the lungs like wind instruments, nor liable to lose its pitch from accidental causes. It is the instrument best suited to give instruction; the number of teachers of the piano is something wonderful, and its pupils comprehend, with a few singular exceptions, all who study music. From these causes, the manufacture of pianos has become a trade of national importance, and it exercises a controlling influence over cognate trades; three fourths of the music sold in the shops is adapted to the pianoforte.

When harmony began to be cultivated in music, and



the pleasure to be derived from it became complicated and refined, the piano was invented. The first instrument whose strings were vibrated by hammers instead of plectrums, was made by Marius, in Paris, in 1716. The piano early became a favorite and indispensable aid to the composers of music, who found it a substitute for the orchestras, whose services few composers have been in a situation to command. They have repaid their obligations by thoroughly testing and improving its capabilities, and by writing for it many of their best and most beautiful compositions.

The Axminster Carpet is manufactured and exhibited by Messrs. Templeton & Co., of Glasgow. The design is liable to the objections urged against the example engraved on page 167 of this work.

One of the most faultless and exquisitely executed works which Italy, the home of the Fine Arts, has contributed to our Crystal Palace, is the bust commencing this

page. The bridal wreath indicates the name—The Betrothed—which the sculptor Pasquale Romanelli, of Florence, has imposed upon his work. The face deserves every praise for its singular sweetness of expression, as if all the virtues and graces of woman belonged to the soul that should animate a face so sweet and fair. It is no

unworthy rival and companion of the Proserpine of Powers, of which we give here a new engraving.

An Aubusson Carpet, meritorious for its workmanship and harmony of colors, is exhibited by the manufacturer, M. Alexander Braquenie, of Paris.

The genius of HIRAM POWERS is represented in the New-York Exhibition by four of his works—The FISHER BOY and bust of PROSERPINE already engraved, and EVE and the GREEK SLAVE which adorn this page of the RECORN. The latter is still the property of the sculptor; the EVE was placed in the Crystal Palace by the courtesy of Col. JOHN L. PRESTON, of Columbus, South Carolina, and until now has never been exhibited to the public.

So many of the works of Powers were never before assembled except in his own studio; and in respect to sculpture generally, the collection is one of unexampled richness and extent in this country. That it has had, and will continue to have its appropriate influence in forming and directing the public taste cannot be doubted. For obvious reasons Americans have enjoyed very few opportunities of seeing sculptures of real merit. Probably, Italian image boys are the only missionaries of art who have found their way to the majority. To thousands, then, of his countrymen these works of Powers have been a revelation of beauty, not less instructive than delightful. We may be sure that after this practical acquaintance with art, they will have clearer notions of its capabilities, and appreciate better the skill, enthusiasm, and genius of the artist.

The Greek Slave has been frequently described, and we need not repeat here the familiar story which she is designed to represent. It was this statue that first introduced the name and merits of Powers to the English public, and it has probably contributed most to his popular fame.

The Eve, like the Greek Slave, is a reproduction of the antique. Connoisseurs, whose judgment we respect, say that "our sculptor's great power resides in his imitative faculty, and the patient skill with which he manipulates the surface of the marble. No modern artist has succeeded so perfectly in giving to his statues the peculiar and indescribable look of flesh, equally removed from the roughness of stone and the glossy polish of porcelain. His elastic muscle seems as if it would yield to the touch." The marble has that delicate softness, which after all, is the peculiar and most imperishable charm of the most beautiful woman. The imagination or creative faculty in Powers is far inferior to his manipulative skill. While this is perfect, his invention is only mediocre. The deficiency is apparent in each of the four works exhibited, but is most striking in the Eve. The face has no meaning. The body, the limbs are the perfection of physical beauty, but the beautiful soul that should animate so much loveliness is wanting. She is not the mythological Eve. She is not the "fairest of her daughters" whom Milton sung. But failing in imaginative works, Powers surpasses all other sculptors in reproducing nature. His portrait busts are perfect—the features and the character are given by him with all the fidelity of life.

The illustrations upon this and the opposite page of the RECORD, have been selected from the small but choice collection of SEVRES PORCELAIN, contributed to the Exhibition by the Government of France. The varied nature of these articles, their graceful forms, and the perfect propriety as well as beauty of their decorations, are

represented, as far as uncolored illustrations can represent them, by our engravings.

The porcelain of Sèvres is the perfection of the ceramie art, and while it would be superfluous to praise works which have so long been the acknowledged standards of excellence, it may be useful to state how that enviable distinction has been obtained. In 1710, the successful experiments of Bottcher, in Saxony, stimulated the manufacturers of France to attempt the production

of similar imitations of oriental china. Their efforts resulted in the discovery of a new composition for porcelain, called *pate-tendre*, or Old Sèvres. It was first manufactured at St. Cloud; afterwards at Chantilly, by workmen trained at the former place; and in 1745, the proprietor, M. Gravant, sold the secret to the Marquis d' Orry, the Minister of Finance. In 1753 Louis XV. became one third owner of the establishment, and gave it the

title of Royal Manufactory; in the following year the factory was transferred to Sèvres, and six years after, the other shares being bought by the king, it was placed under the sole direction and patronage of the government.

During all subsequent public changes and revolutions it has continued under the same fostering care; for it is the peculiar honor of the successive governments of France, that they have uniformly encouraged public industrial institutions with a free and efficient liberality, and by employing the best artists and scientific men to direct and improve them, have made the workshops of France the schools of taste and excellence for the workmen of the world.

The manufacture of *porcelaine dure* at Sèvres was begun in 1768 by the chemist Macquer, and in 1805 entirely superseded the *tender* variety already mentioned. All the articles in the Exhibition are of the *hard* porce-

lain. Its composition is usually, Kaolin (China clay), 48 parts; sand, 48 parts; and chalk, 4 parts. These materials are ground to very fine powder with water, and, the excess of water being removed, the *slip* is passed through the mill, and is ready for turning, moulding, and casting, by which operations, single, or combined, all the objects must be produced. Handles and other ornamental parts are cast separately, and afterwards attached. The vessels after being baked are termed

biscuit, and are opaque, porous, and absorbent. They are then dipped into a liquid glaze of feldspar and alkali, and exposed to the intense heat of the glazing kiln, from which they emerge milky white, and with a surface like polished marble. The glaze is a true glass which flows into pores of the *biscuit*, and forms with it a homogeneous

body. The colors used in the painting are all metallic oxyds, ground up with a flux of red lead, borax, and flint, which are vitrified and made imperishable by another firing

The beautiful engraving which commences this page, is a faithful copy in every thing except color, of one of the Gobelins Tapestries exhibited by order of the French Government. Though possibly it may not be the most meritorious in an artistic and technical point of view, it appears to us the most pleasing of the tapestries that grace our

Crystal Palace. The subject is taken from Æsop's apologue of the THE WOLF AND THE LAMB, a favorite in the boyish days of every one, and none the less popular, when a mature experience has confirmed its truthful picture of the pretexts which tyranny invents, when it wishes to trample upon defenceless innocence. This piece was executed in 1842 by Thiers, after a painting by Desportes.

A WORK TABLE, carved in Ebony, with the rich and grotesque ornaments invented by the fertile fancy of mediæval decorators, is exhibited by the designer and manufacturer, CARL HILGER, of Düsseldorf.

The group of sculpture called CUPID CAPTIVE, is the work of an eminent Belgian sculptor, M. FRAIKIN. The composition of this group, especially the upper part, is very graceful, and is deserving of high praise.

A bas-relief in plaster, designed for an architectural ornament, and called a LYRIC CENTRE, is contributed to the Exhibition by the designer and manufacturer, THOMAS HEATH, of Philadelphia. It consists of two circles of portrait busts interspersed with decorative designs having reference to music. In the larger circle we recognise busts of Jenny Lind, Anna Bishop, Miss Hayes, &c.; in the inner circle, Sontag, Alboni, Badiali, &c

The centre is six feet in diameter.

Another object deserving great praise for its beauty and the perfection of its workmanship, is the TABLE on the left of the page. Its top is a circular plate of porcelain exquisitely painted, and set in a gilt border. It is supported by three curved and foliated gilt stems which rise from a metallic triangular base. They support at the centre a globe of rich blue porcelain set with gilt stars. It is exhibited by LA HOCHE.

CORNELIUS & Co., of Philadelphia, exhibit a bronze gilt CANDELABRUM, which by removing the top, may also serve as a centre-dish.

A rich and highly finished example of buhl furniture is exhibited by RINGUET LE PRINCE & Co. The companion cabinet has been engraved on a previous page.

We employ this page to represent a specimen of PAPER HANGINGS, exhibited by JULES DESFOSSE, of Paris. The opposite page is occupied with another example, selected from the contributions of Messrs. MORANT & BOYD, of London.

Both of these specimens are examples of architectural decorations, designed to cover the wall and adorn it, to the exclusion of all paintings and similar objects of taste. Paper hangings of this description are admissible in public halls and saloons, and sometimes perhaps in the entrance-hall, but not elsewhere, of a private residence. A drawing-room, library, or chamber requires a different treatment. In such a situation the covering of the walls should have the same relation to the furniture, objects of art, and occupants of the apartment,

that a background sustains in a good picture, not overpowering the principal figures and drawing attention away from them, but enriching their effect, and supporting and aiding in the general beauty or magnificence. Landscapes, therefore, whether large or small, groups of figures, imitative carving and panelling, *et id genus omne*, should

be carefully avoided in paper hangings; on the contrary, their decorations should be subdued in color, flat and conventional in design, and entirely free from imitative light and shade. Few things are more unpleasing to a cultivated eye than the bunches of gaudy flowers and foliage perspectively rendered in the intensest colors, and the landscapes, repeated with endless iteration on the walls. This may be called a petty offence against good taste, but trifling annoyances are at length intolerable when it is difficult or impossible to avoid their constant repetition.

The bronze Clock on this page is one of the extensive contributions of Lerolle, of Paris.

La Roche, of Paris, whose beautiful collection of bronzes we have before noticed, is the exhibitor of the gilt bronze Vase, engraved herewith.

We have already engraved several specimens of marble Mantlepieces, of which the exhibition furnishes a fair variety. This one is contributed by Francesco Paccliani, of Florenee. It is of white marble; the seulpture at the top is from Guido's Aurora. The whole design is graeeful and elegant.

We introduce upon this page two examples of TERRA-COTTA CASINGS, which may be used either for doorways or windows. They are exhibited by the manufacturer, ALEXANDER YOUNG, of New-York. The ease with which it may assume any required constructive form, its strength, and especially its fire-proof qualities, commend

casings of this material to our builders, and we hope to see them come into extensive use.

The eminent manfacturers of mirror frames, Messrs. E. NEWLAND & Co., of Philadelphia, exhibit the large and massive MANTLE MIRROR, which we here engrave. Its

style is renaissance, characterized by its usual scroll work with figures interspersed. Upon the arch there is a copy of the Amazonian group of Kiss. The mechanical execution of this frame is of undisputable excellence. The mirror plate, which is of the finest glass manufactured at St. Gobain, measures 62 inches by 84 inches.

A conspicuous ornament of the West Nave of the Crystal Palace is the richly decorated Door, which we here engrave. It is cast-iron heavily gilt, and its panels are

filled with plate glass. It is exhibited by J. Aubanel & Co., of Paris, and is one of a set made for a summer palace of the Pasha of Egypt.

This and the subsequent pages contain the select contributions of Messrs. Elkington & Co., of Birmingham and London.

The first engraving represents a bronze statuette, Cupid with the Lyre, an electro type copy after Thorwaldsen.

It is followed by a Race Plate, designed by Gunkel. The Iliad Salver, electrotyped in solid silver, represents the prayer of Thetis to Jupiter, with scenes from Homer

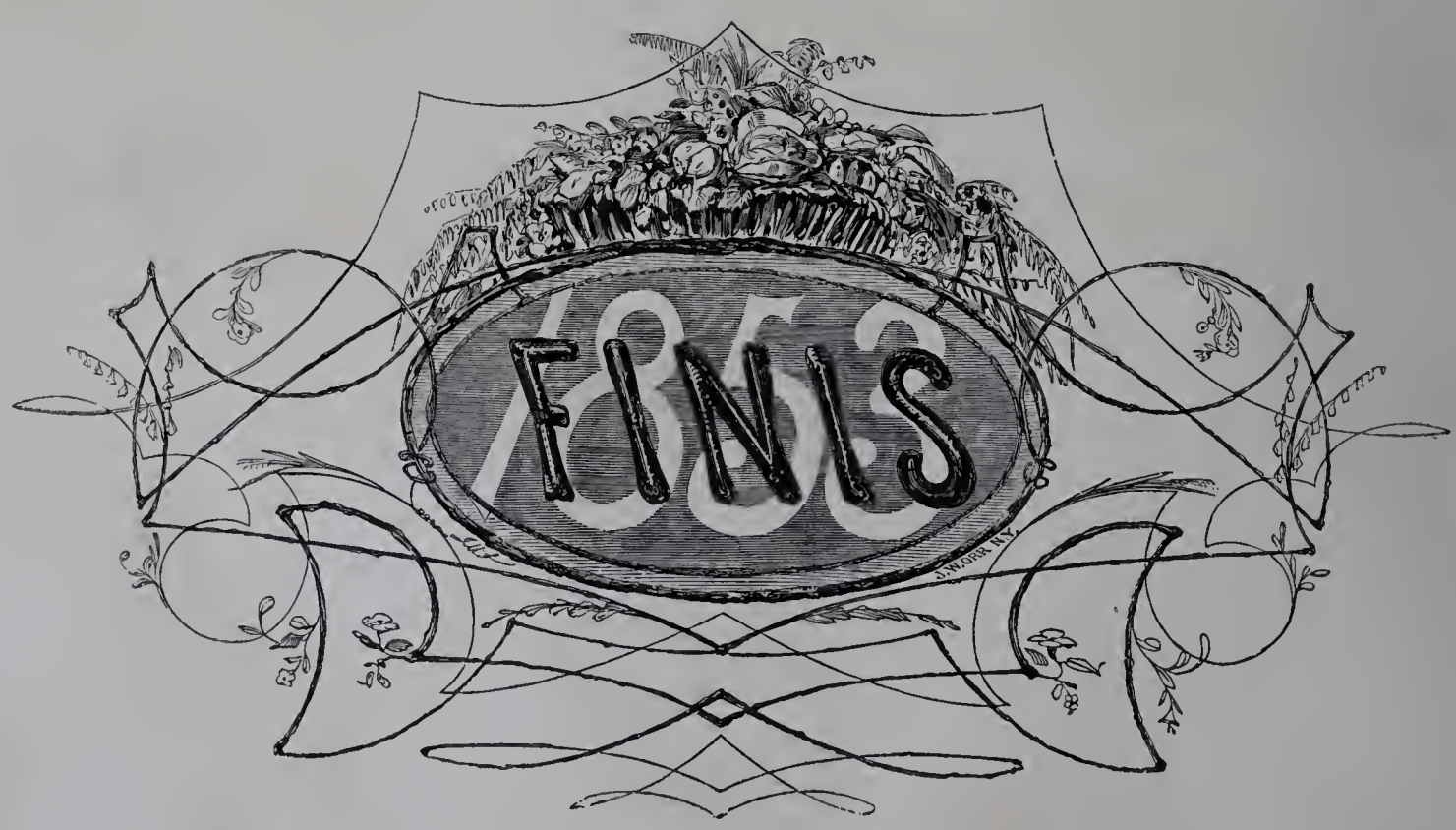
in the border. The SIDEBOARD DISH, electrotyped from the original in the museum of the Louvre, was made for the

Queen. It contains a series of allegorical representations, divided by arabesques. Temperance presides, in the centre, over the four elements, represented in the bas-reliefs of the inner ring. The eight subjects of the outer ring typify as many branches of science and art. These salvers are works of exquisite beauty, and exhibit the highest attainment of the art of electrotyping as applied to the production of works of art. The simultaneous invention of Jacobi at St. Petersburg, and Spencer, at Liverpool, in the year 1838, was adopted by Messrs. Elkington in 1840, when they took out a patent for the process both in England and France. The art has extended with wonderful rapidity, and has been brought to such perfection, that looking at its results in the works exhibited by Messrs. Elkington, it is difficult to see how it can be improved. This firm employ about 500 workmen at Birmingham, executing the designs of some of the best artists of the day. About 30 other English manufacturers are licensed to use the process. Electrotypy is one of the most valued gifts which science has conferred upon art, since it brings the most magnificent works, such as formerly only the wealthiest could obtain, within the reach of all lovers of art.

The objects which fill page 207, explain themselves sufficiently without a description. We cannot leave them, however, without directing attention to the fine workmanship of the VASES and DECANTERS mounted in silver. The small ANTIQUE VASE with a bas-relief representing a procession, is also a work of perfect beauty. It is executed in oxydized silver. On this concluding page, we have engraved a FRUIT DISH of graceful shape, executed in silver. Opposite is a bronze bust of the Duke of Wellington, modelled by Weigall. The likeness

is thought to be good.

Between these objects is a silver SIDEBOARD EWER, named The Challenge, which is the last of our selections from the imposing and magnificent collection of plate, contributed to our Crystal Palace by Messrs. GARRARD of London.



SCIENCE AND MECHANISM